

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

ARBOR GLOBAL STRATEGIES LLC, a Delaware Limited Liability Company,)	
)	Case No.
)	
Plaintiff,)	DEMAND FOR JURY TRIAL
v.)	
)	
SAMSUNG ELECTRONICS CO., LTD., a)	
Korean corporation, SAMSUNG)	
ELECTRONICS AMERICA, INC., a New)	
York corporation, and SAMSUNG)	
SEMICONDUCTOR, INC., a California)	
corporation,)	
)	
Defendants.)	
)	
)	
)	

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Arbor Global Strategies LLC (“Arbor”) files this Complaint for Patent Infringement and Demand for Jury Trial against defendants Samsung Electronics Co., Ltd., (“SEC”), Samsung Electronics America, Inc. (“SEA”), and Samsung Semiconductor, Inc. (“SSI”) (collectively, “Defendants” or “Samsung”) and alleges as follows:

THE PARTIES

1. Arbor is a Delaware corporation engaged in the electronics and computer industry and with its principal place of business in Glenbrook, Nevada. Arbor developed and holds patents directed to novel aspects of integrated circuit (“IC”) technology, including the ability to increase the amount and speed of connections within an IC module. This patented IC technology has important applications, particularly in devices with restricted form factors, such as in modern smartphones and tablets.

2. Mr. D. James Guzy is the Chairman, President, and Co-founder of Arbor and has been with the parent company of Arbor since 1969. Mr. Guzy is an acknowledged pioneer in Silicon Valley, co-founded the Intel Corporation, was Intel's longest serving director, and has served in various senior and advisory capacities in several other technology companies. Mr. Guzy has a MS from Stanford University, a BS from University of Minnesota, and is one of the inventors on Arbor's patents.

3. SEC is a multinational corporation incorporated under the laws of the Republic of Korea having its headquarters located at 129 Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea. On information and belief, SEC has approximately 263 subsidiaries, including Defendant SEA, which collectively with SEC operate four business divisions: Consumer Electronics, which designs, manufactures, and sells products such as digital televisions and computer monitors; Information Technology & Mobile Communications, which designs, manufactures, and sells products such as mobile phones, communication systems, and computers; Device Solutions, which designs, manufactures, and sells products and services within its Semiconductor Business including memory products, LSI products such as system-on-chip ("SoC") semiconductor devices and image sensors, and foundry services, as well as products within its Display Business; and Harman, which designs, manufactures, and sells connected car systems, audio and visual products, enterprise automation solutions, and connected services.

4. SEA is a New York corporation having its principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey, 07660. On information and belief, SEA is a wholly-owned subsidiary of SEC that markets and sells products and services within the United States that are designed, manufactured, and/or provided by SEC and/or one or more of SEC's

approximately 263 subsidiaries and that fall within at least one of SEC's CE, IM, and DS business divisions, including Samsung smartphones and tablets. On information and belief, SEA maintains an office at 6625 Excellence Way, Plano, Texas 75023 that is involved in making, using and/or selling Samsung smartphones and tablets. Defendant SEA may be served with process through its registered agent CT Corporation System, 1999 Bryan St., Suite 900, Dallas, Texas 75201-3136.

5. SSI is a California corporation having its principal place of business at 3655 North First Street, San Jose, California, 95134. On information and belief, SSI is a wholly-owned subsidiary of SEA that markets and sells Samsung semiconductors. Defendant SSI may be served with process through its registered agent National Registered Agents, Inc., 1999 Bryan St., Suite 900, Dallas, Texas 75201-3136.

6. On information and belief, SEC, SEA, and SSI work collectively with one another, and with SEC's other subsidiaries, in the design, manufacture, importation, distribution, marketing, and selling of Samsung smartphones and tablets.

JURISDICTION AND VENUE

7. This action arises under the Patent Act, 35 U.S.C. § 101 *et seq.* This Court has original jurisdiction over this controversy pursuant to 28 U.S.C. §§ 1331 and 1338.

8. Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391(b) and (c) and/or 1400(b).

9. This Court can exercise personal jurisdiction over Samsung because Samsung maintains substantial operations located in this District, and therefore Samsung's affiliations with this District are so substantial as to render it essentially at home in this District. Additionally, this Court can exercise personal jurisdiction over Samsung in this action because Samsung has

committed acts of infringement and/or inducement of infringement in this District, because Plaintiffs' claims arise out of and relate to Samsung's acts of infringement and/or inducement of infringement in this District, and because the exercise of jurisdiction by this Court over Samsung in this action would be reasonable. Accordingly, Samsung has minimum contacts with this District such that the maintenance of this action within this District would not offend traditional notions of fair play and substantial justice.

10. Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391(b) and (c) and/or 1400(b) because Samsung resides in this District and because Samsung's acts of infringement and/or inducement of infringement take place in this District.

ARBOR'S INNOVATIONS

11. Arbor pioneered and developed novel IC technologies, for which it holds several patents. The innovations in these patents relate to a new type of IC called a "stacked die hybrid," which allows for an extremely compact processor module with increased data speeds and processing efficiency. These inventions include the use of inter-cell through-silicon vias ("TSVs") within an integrated circuit module, such as between die layers. This novel use of TSVs provides for increased efficiency and a smaller form factor than traditional IC fabrication techniques allowed for.

12. As explained in the specification of Arbor's patents, prior art approaches to IC module design connected stacked die layers using metallization contacts at the edges of the die. This prior art approach provided fewer and slower connections than possible with the inter-cell use of TSVs developed by Arbor, which also improved system bandwidth and reduced power requirements.

ARBOR'S ASSERTED PATENTS

13. On August 24, 2004, the USPTO issued to Jon. M. Huppenthal and D. James Guzy U.S. Patent No. 6,781,226 (“the ‘226 Patent”), titled “Reconfigurable Processor Module Comprising Hybrid Stacked Integrated Circuit Die Elements.” A true and correct copy of the ‘226 Patent is attached to this Complaint as **Exhibit 1** and is incorporated by reference herein.

14. All rights, title, and interest in the ‘226 Patent have been assigned to Arbor, who is the sole owner of the ‘226 Patent.

15. The ‘226 Patent is generally directed towards a module comprising stacked IC die elements constructed by stacking thinned die elements connected using TSVs. The ‘226 Patent discloses and specifically claims inventive concepts that represent significant improvements over conventional ICs because it results in a much thinner form factor with greater parallelism, higher throughput and reduced power requirements for many applications.

16. On October 16, 2007, the USPTO issued to Jon. M. Huppenthal and D. James Guzy U.S. Patent No. 7,282,951 (“the ‘951 Patent”), titled “Reconfigurable Processor Module Comprising Hybrid Stacked Integrated Circuit Die Elements.” A true and correct copy of the ‘951 Patent is attached to this Complaint as **Exhibit 2** and is incorporated by reference herein.

17. All rights, title, and interest in the ‘951 Patent have been assigned to Arbor, who is the sole owner of the ‘951 Patent.

18. The ‘951 Patent is generally directed towards a module comprising stacked IC die elements constructed by stacking thinned die elements connected using TSVs. The ‘951 Patent discloses and specifically claims inventive concepts that represent significant improvements over conventional because it results in a much thinner form factor with greater parallelism, higher throughput and reduced power requirements for many applications.

19. On January 18, 2011, the USPTO re-issued to Jon. M. Huppenthal and D. James Guzy U.S. Patent RE42,035 (“the ‘035 Patent”), titled “Reconfigurable Processor Module Comprising Hybrid Stacked Integrated Circuit Die Elements.” A true and correct copy of the ‘035 Patent is attached to this Complaint as **Exhibit 3** and is incorporated by reference herein.

20. All rights, title, and interest in the ‘035 Patent have been assigned to Arbor, who is the sole owner of the ‘035 Patent.

21. The ‘035 Patent is generally directed towards a module comprising stacked IC die elements constructed by stacking thinned die elements connected using TSVs. The ‘035 Patent discloses and specifically claims inventive concepts that represent significant improvements over conventional because it results in a much thinner form factor with greater parallelism, higher throughput and reduced power requirements for many applications.

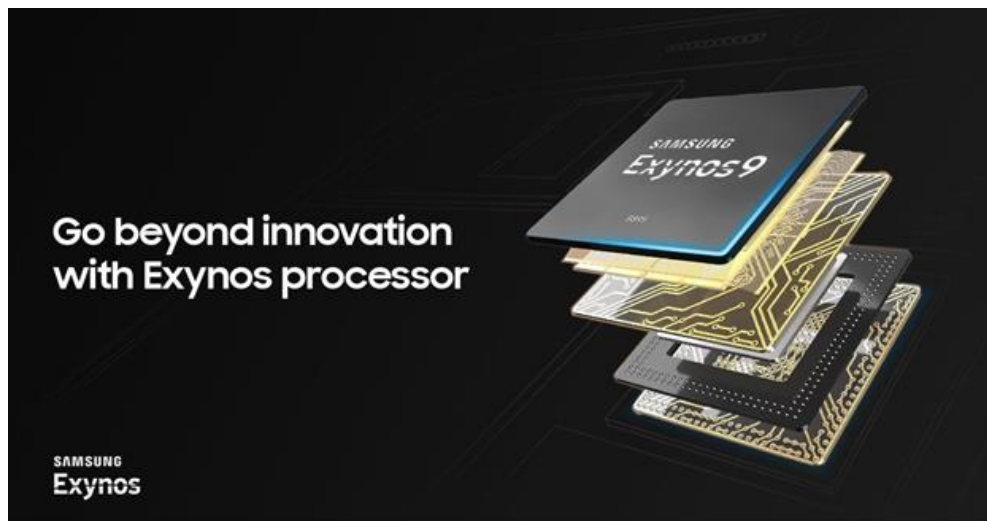
22. The ‘226, ‘951, and ‘035 Patents are generally directed towards a module comprising stacked IC die elements constructed by stacking thinned die elements connected using TSVs. The ‘226, ‘951, and ‘035 Patents disclose and specifically claim inventive concepts that represent significant improvements over conventional systems by teaching persons skilled in the art how to create and use a IC that allows for smaller form factors and increased performance compared to what was known at the time in 2001. In particular, the ‘226, ‘951, and ‘035 Patents disclose more than just a simple combination of generic components that are used to perform conventional activities. These patents represent a pioneering use of TSVs in IC products which has been widely adopted in the industry, particularly by Samsung.

DEFENDANTS' INFRINGING PRODUCTS AND TECHNOLOGIES

23. Defendants make, use, sell, offer for sale, and/or import into the United States and this District products and services that utilize Exynos, ISOCELL, DDR4, and IMX Image Sensor ICs (collectively, the “Accused Products”).

Samsung Exynos

24. The Exynos is a System on Chip (SoC) utilizing ARM-based processors for mobile devices. Exynos includes several IC die elements such as the CPU, GPU, memory, and modem stacked in the same SoC package.



25. Samsung’s Widcon technology in the Exynos greatly reduces latencies associated with memory read and write operations by using TSVs to connect heterogeneous stacked die elements. The TSVs function in the Exynos to provide a number of contact points that are distributed throughout the surfaces of the die elements and traverse a thickness of the IC to electrically couple the stacked die elements and improve processing bandwidths. The DRAM and the CPU IC die elements are electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements. The TSVs connect these multiple die

elements, allowing for faster processing speeds and increased memory bandwidths. Samsung has touted their use of TSVs described in Arbor's patents, as shown below.



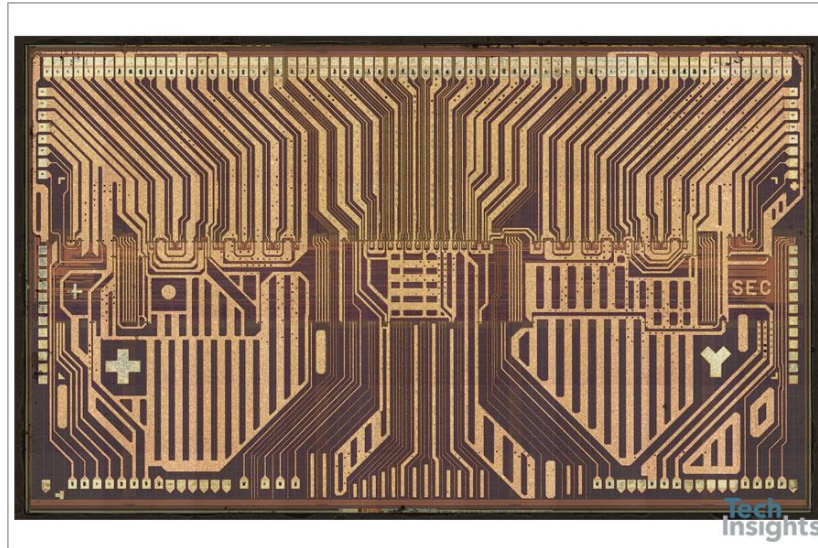
26. Samsung utilizes the Exynos in a number of its different products as a SoC, including in mobile phones, computers, and digital cameras. Samsung products that includes the Exynos include its mobile devices like different versions of the Galaxy mobile phone and Galaxy Note tablet.

Samsung ISOCELL

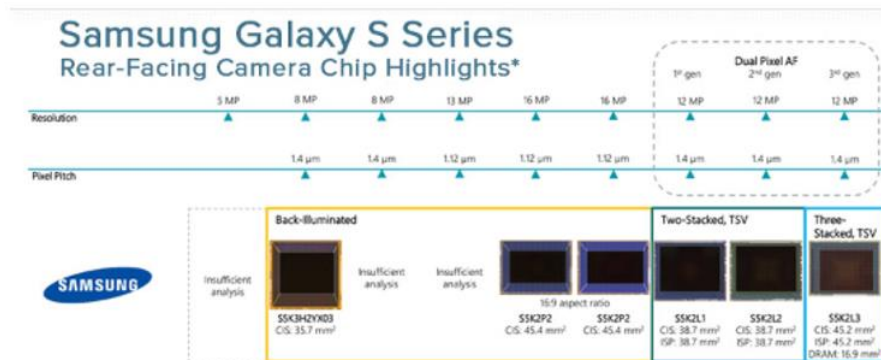
27. The ISOCELL (including ISOCELL Plus) is an image sensor used for the camera function in many Samsung Smartphone and tablet mobile devices. The ISOCELL provides rich detail, vivid color, and accurate focus in a form factor appropriate for slim mobile devices. ISOCELL combines 3D-BSI with Front-side, Full-depth, Deep-Trench Isolation (F-DTI) and Vertical Transfer Gate (VTG). This provides increased light sensitivity and higher color fidelity even in poor lighting conditions.

28. The ISOCELL has an Image Sensor Processor ("ISP"), Redistribution Layer ("RDL"), and DRAM Layer that are electrically coupled and interconnected by TSVs. The

below image shows the DRAM die for the ISOCELL with the RDL intact and where the RDL includes contact points that are located at the DDR4 spine.



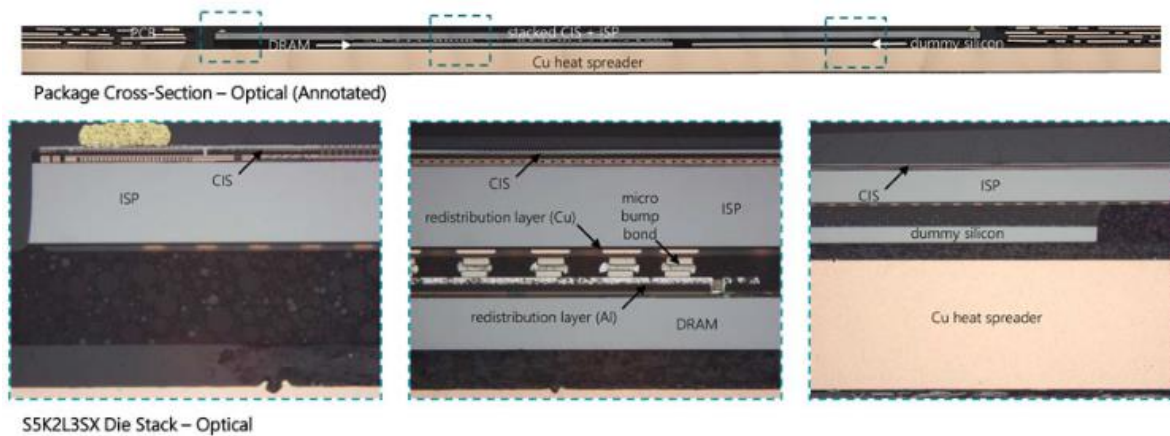
29. Samsung has announced the use of TSVs in its ISOCELL image sensors.



See <https://www.techinsights.com/about-techinsights/overview/blog/samsung-galaxy-s9-camera-teardown/>

30. The below gives an alternative view of the die stack for ISOCELL and demonstrates the use of TSVs.

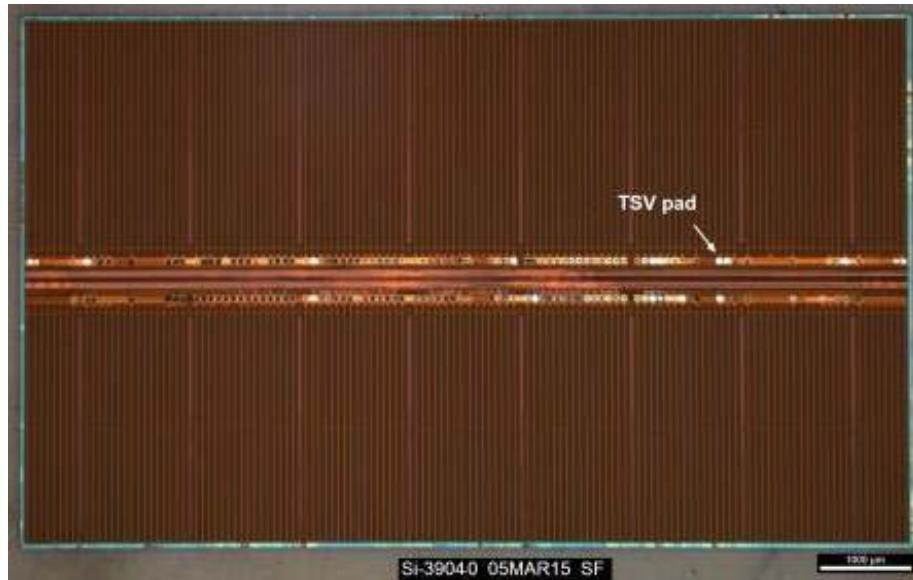
Samsung S5K2L3SX Overview



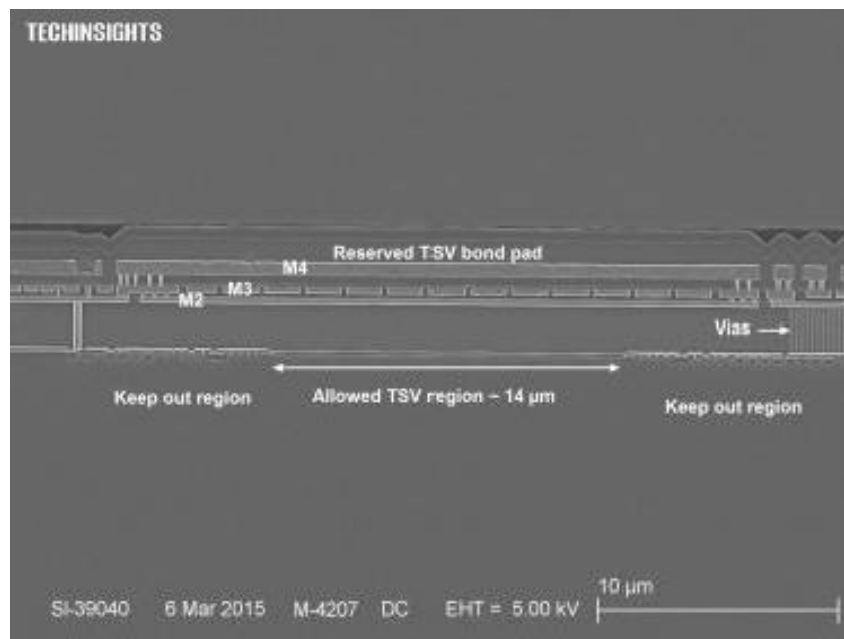
31. Samsung utilizes the ISOCELL in a number of its different products as an image sensor, including mobile phones, computers, and digital cameras. Samsung products that include the ISOCELL include its different versions of its mobile devices like the Galaxy mobile phone and Galaxy Note tablet.

Samsung DDR4 Memory

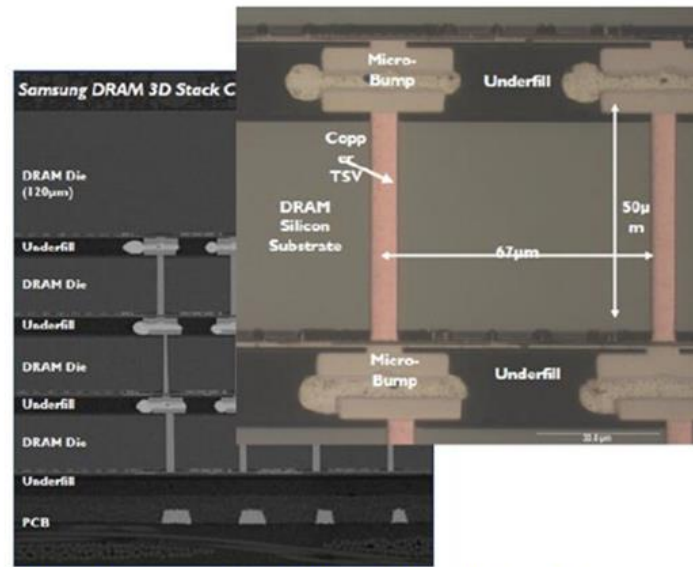
32. Samsung's DDR4 Memory is a memory module that is designed to work with processor chips for computational and data processing applications. The DDR4 Memory includes multiple die elements stacked and electronically connected through TSVs, and each of which constitutes arrays that are configurable to be programmable for storage and retrieval of data.



33. The DDR4 processor modules include at least two IC die elements using TSVs.



34. Shown below is a cross-sectional image and a zoomed-in image of a Samsung DDR4 DRAM stack, wherein each DRAM die element is electrically connected to another DRAM die element using TSVs.



See <http://electroiq.com/insights-from-leading-edge/page/9/>.

35. Samsung products that includes DDR4 Memory include its computing devices such as different versions of Samsung computer systems.

Sony IMX Sensor

36. Certain Samsung mobile phones and tablets use Sony's IMX family of image sensors.

37. The IMX Sensor is an image processing module with an IC die element including a programmable array, such as a memory array or an application specific integrated circuit ("ASIC").

38. IMX image sensor is an image processing module that includes an IC, such as a DRAM cell array, that can be programmed for data storage and retrieval.

The details were given in a paper at the ISSCC conference and it actually looked like the real thing, so this definitely caught the attention of our image-sensor experts inside TechInsights. Confirming its production status, at Mobile World Congress, Sony announced their Xperia XZ Premium and XZs phones, with the Motion Eye camera system capable of 960 fps. We got hold of an Xperia XZs as soon as it was available, cross-sectioned the rear-facing camera chip, and lo and behold, we indeed have a three-stack; the CMOS image sensor (CIS) is mounted face-to-back on the DRAM, which is face-to-face with the image signal processor (ISP).

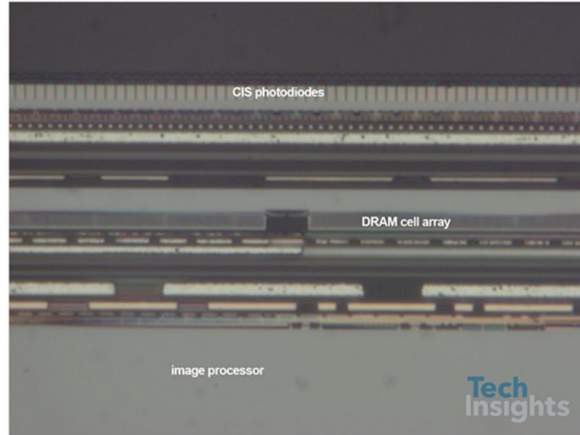
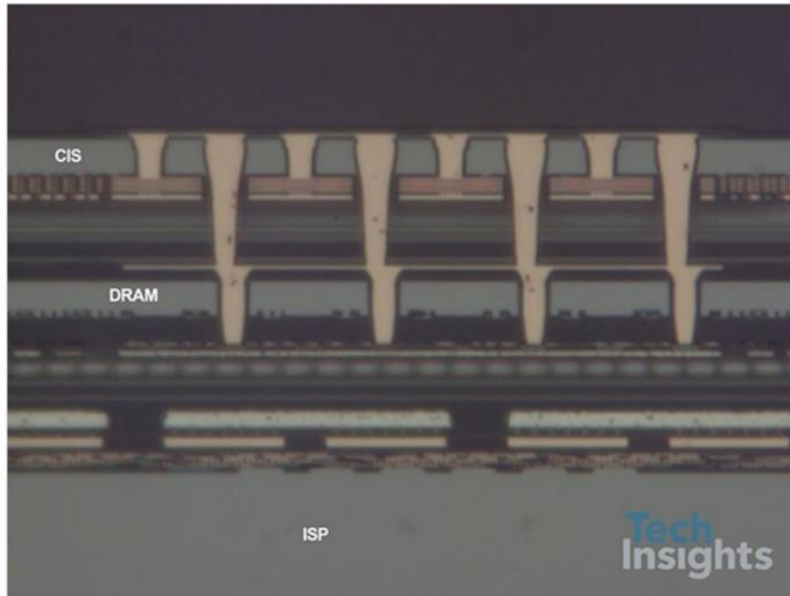


Figure 1: Source: Sony IMX400 3-Layer Stacked (Exmor RS) CMOS Image Sensor, TechInsights

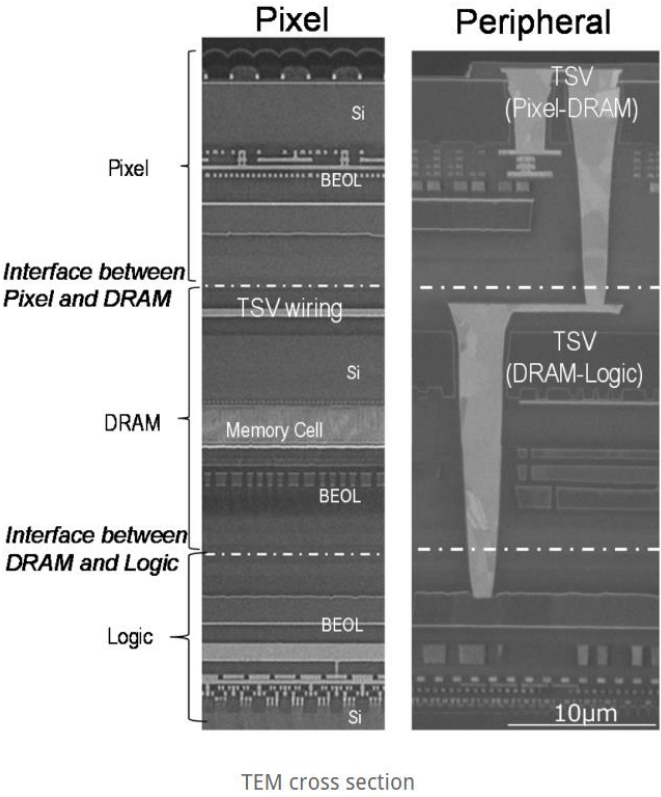
See www.eetasia.com/news/article/sony-embeds-dram-in-image-sensors.

39. IMX further includes an ISP for processing captured images connected to the DRAM programmable cell array and a CMOS image sensor (CIS).



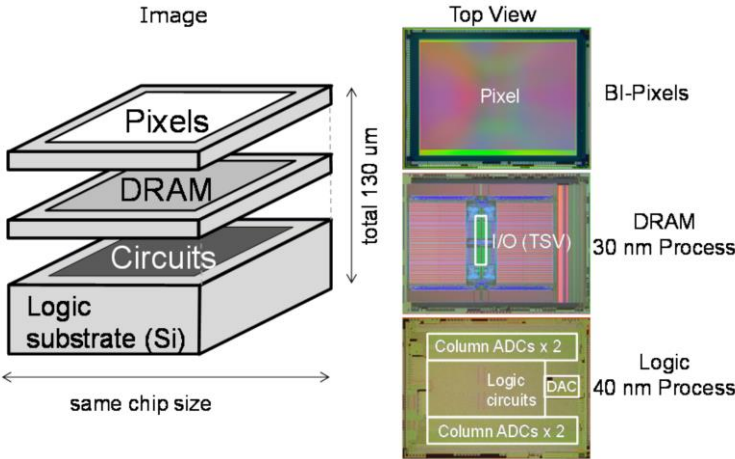
See <http://electroiq.com/insights-from-leading-edge/2017/08/iftle-346-sony-introduces-stacked-image-sensor-with-dram-in-xperia-xz-phones/>
See also https://www.systemplus.fr/wp-content/uploads/2017/07/SP17343_Sony_IMX400_Trilayer_Stacked_CIS_Flyer_System_Plus_Consulti.pdf

40. IMX is a tri-layer, stacked, image processing module that includes the image processing logic layer, the programmable DRAM memory cell array, and the CIS die element that are stacked over each other. The IC circuit die element can include the programmable DRAM memory cell array for image data storage and retrieval.



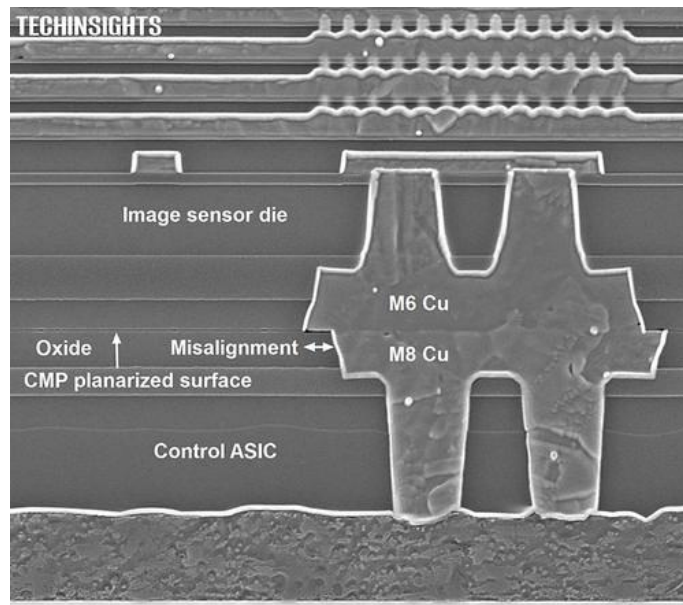
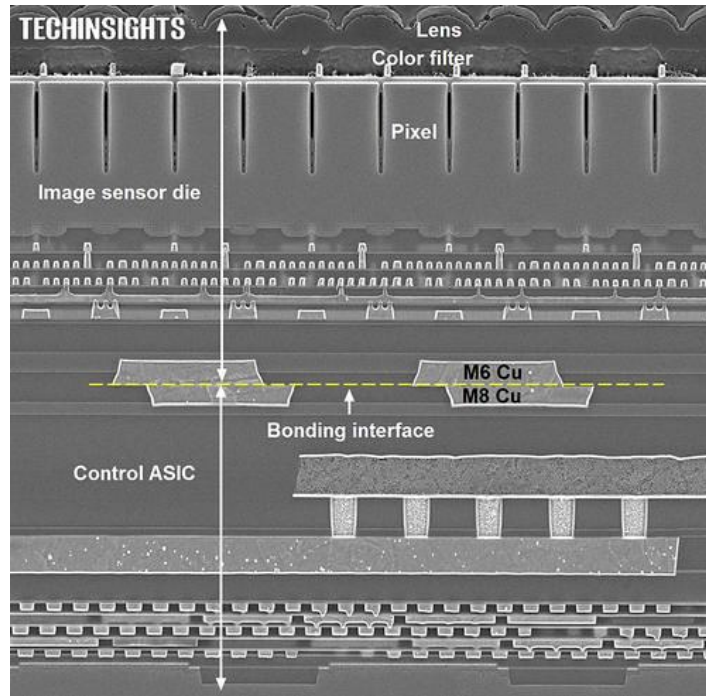
See <https://fuse.wikichip.org/news/763/iedm-2017-sonys-3-layer-stacked-cmos-image-sensor-technology/>.

41. Shown below is a schematic illustration of Sony’s triple-die stacked CIS structure including the pixel image capture layer, the DRAM programmable array, and the ISP logic layer for processing the images captured by the pixel layer. The pixel layer and the DRAM layer can include IC dies that have been thinned-down to enable electrically connectivity using TSVs.



See <https://fuse.wikichip.org/news/763/iedm-2017-sonys-3-layer-stacked-cmos-image-sensor-technology/>

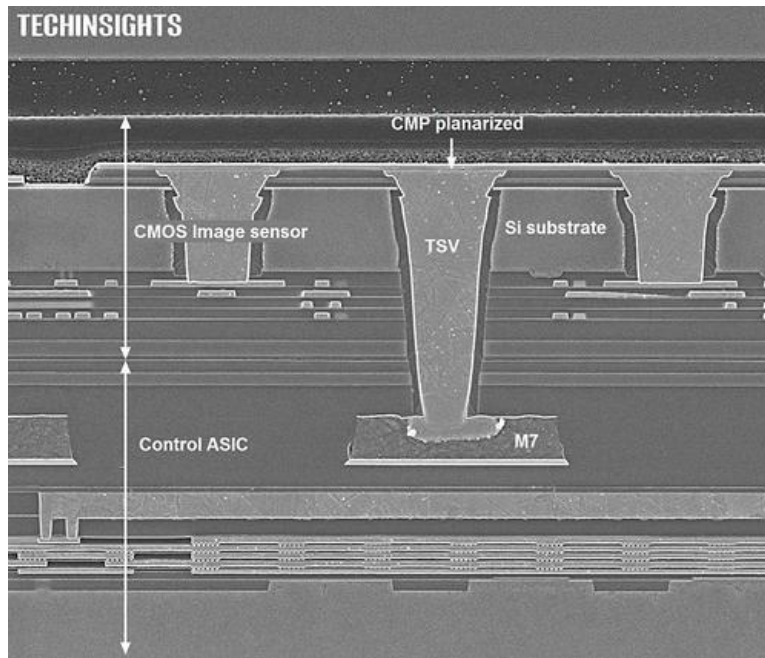
42. IMX can also be a bi-layer, stacked, image processing module that includes at least an IC die element, such as an ASIC programmable logic layer for processing captured images, and a CIS integrated circuit die element for capturing the images.



See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

See also <http://image-sensors-world.blogspot.com/2016/03/sony-imx260-in-samsung-galaxy-s7.html>

43. IMX includes IC die element, such as a control ASIC programmable layer for processing captured images, and a CIS IC die element for capturing the images.



See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

44. Samsung utilizes the IMX image sensor in a number of its different products including in mobile phones, tablets, computers and digital cameras. Samsung products that include the Sony IMX image sensor include its mobile devices like different versions of the Galaxy mobile phone and Galaxy Note.

COUNT I

(Direct Infringement of the '226 Patent pursuant to 35 U.S.C. § 271(a))

45. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

46. Defendants infringe at least Claim 13 of the ‘226 Patent in violation of 35 U.S.C. § 271(a).

47. Defendants’ infringement is based upon literal infringement or, in the alternative, infringement under the doctrine of equivalents.

48. Defendants’ acts of making, using, importing, selling, and offering for sale infringing products and services were without the permission, consent, authorization, or license of Arbor.

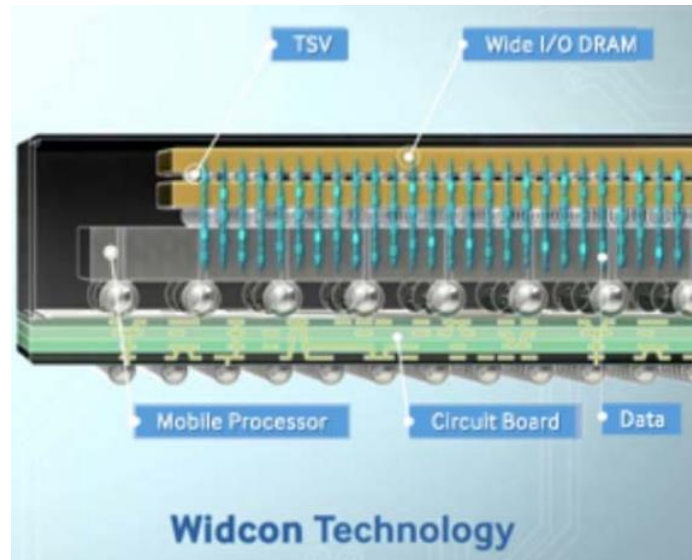
49. Defendants’ infringement included, the manufacture, use, sale, importation and offer for sale of Defendant’s IC products that utilize processor modules that include multiple die elements stacked and electronically coupled through TSVs, including Samsung Exynos, ISOCELL, DDR4 Memory, IMX Sensor, and products including these ICs, including Galaxy mobile phones, Galaxy Note, cameras, and Samsung computers, and including those Samsung products that use Sony IMX image sensors (collectively, the “‘226 Accused Products”).

50. The ‘226 Accused Products practice the patented invention of the ‘226 Patent and infringed the ‘226 Patent because they make, sell, offer for sale, and/or use the Accused Products which include processor modules that include multiple die elements stacked and electronically coupled through TSVs. Using the patented technology, the form factors of the ‘226 Accused Products can be in a size that is reduced without compromising capabilities.

51. Samsung Exynos is a mobile processor module that includes a programmable array IC die element and where the DRAM unit can function as a first IC die element for data storage and retrieval.

52. Samsung Exynos includes at least one microprocessor IC die element stacked with and electrically coupled to a programmable array in an IC die element. For example, the

Exynos includes a second IC die element, such as the CPU, that is stacked over and electrically coupled to the first IC die element using TSVs. Samsung Exynos includes the first IC functional element, such as the DRAM unit, and another IC die element, such as the CPU. The DRAM is programmable as a processing element and is functional as a processing element. The DRAM unit can function as an IC for data storage and retrieval to accelerate reconfiguration of the CPU.

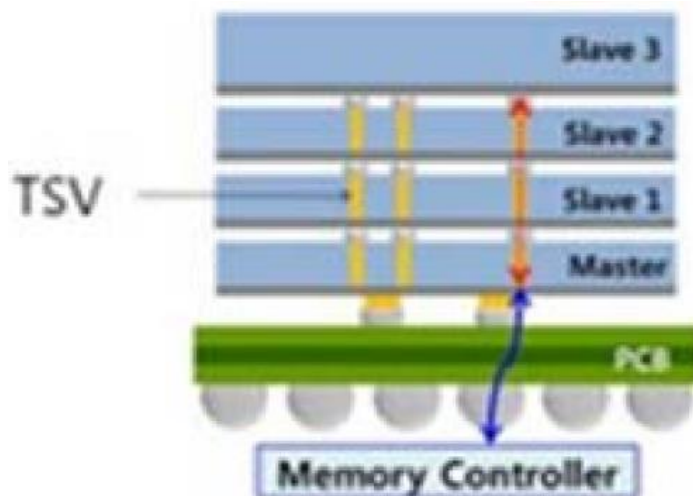


53. Samsung's ISOCELL is a processing module that includes a programmable array IC die element. As shown below, the image signal processor (ISP) interfaces with a programmable array of memory including the RDL and DRAM layer and includes at least one microprocessor IC die element such as an ISP that is stacked with and electrically coupled to the RDL and DRAM layer.

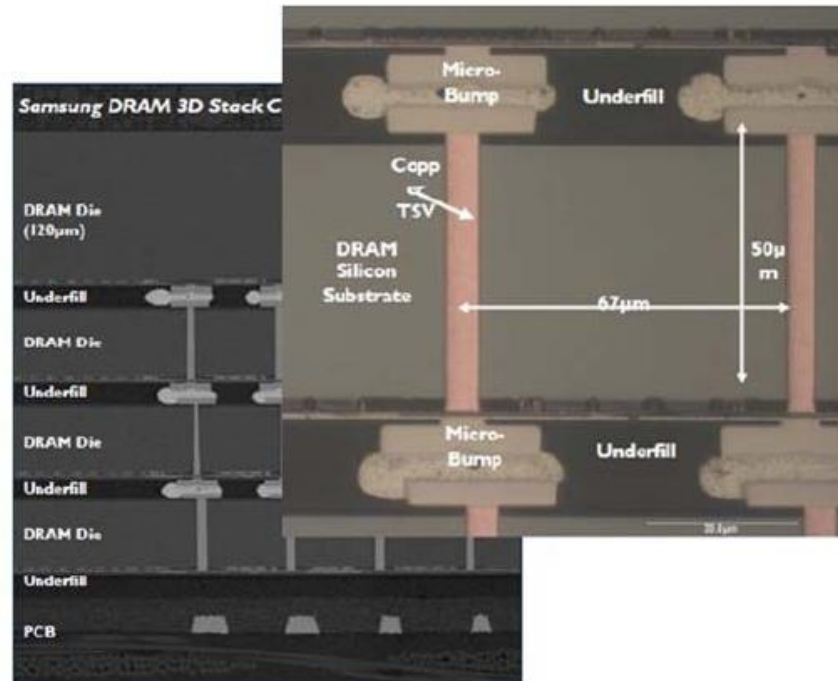


54. As a result, Samsung's ISOCELL improves the processing of data shared between the microprocessor, such as the ISPs and the RDL and DRAM layer by providing faster readout to external memory and better processing.

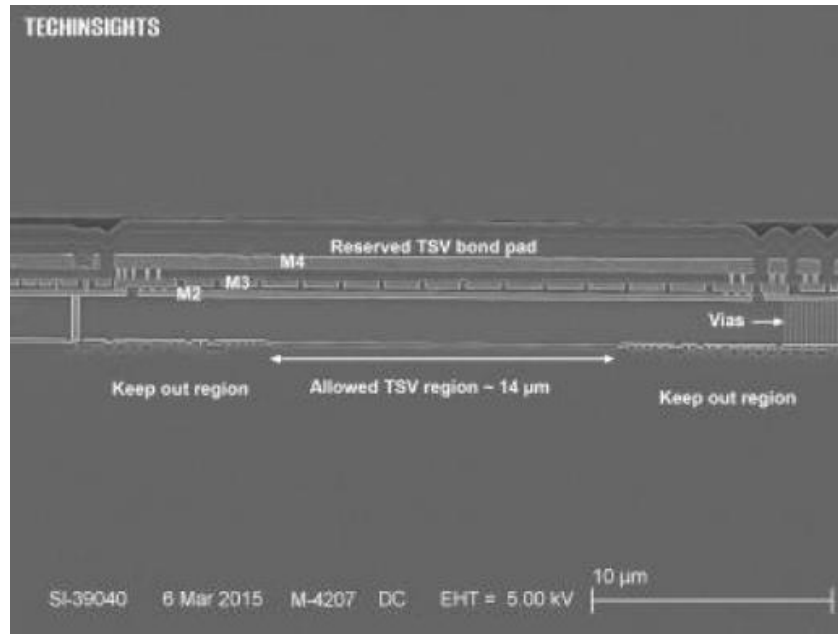
55. Samsung DDR4 are designed and used to work with processor chips comprising a programmable array IC die element. As shown below, Samsung's DDR4 has a special design through which the master chip embeds the data buffer function to optimize module performance and power consumption.



56. DDR4 processor modules include multiple memory die elements stacked over each other and electrically connected with TSVs.



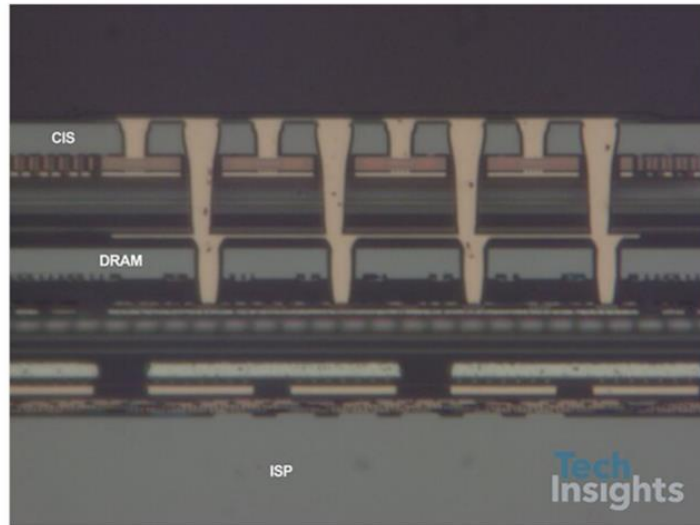
57. Samsung DDR4 include at least one microprocessor IC die element stacked with and electrically coupled to a programmable array. As shown below, Samsung DDR4 includes a microprocessor IC die element stacked with and electrically coupled using TSVs. As seen from the cross-sectional images below of Samsung's DDR4, each memory die elements that allow TSVs to connect to a memory die elements, where TSVs connect the first memory die element to another die element.



58. Samsung DDR4 accelerate the processing of data shared between the microprocessor and a programmable array. As shown below, Samsung DDR4 has a special design through which the master chip embeds the data buffer function to optimize module performance and power consumption.

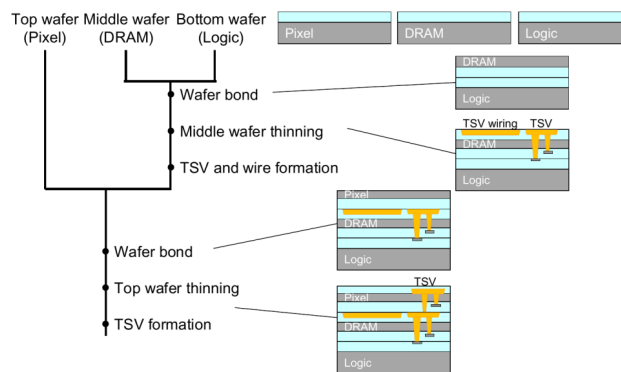
59. IMX Sensor includes an IC die element, such as the DRAM cell array, and an IC die element, such as the CIS, electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements, and wherein the contact points traverse each of the die elements through a thickness thereof.

60. IMX Sensor includes the DRAM cell array and the CIS IC die elements that are electrically coupled by a number of contact points, such as TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.

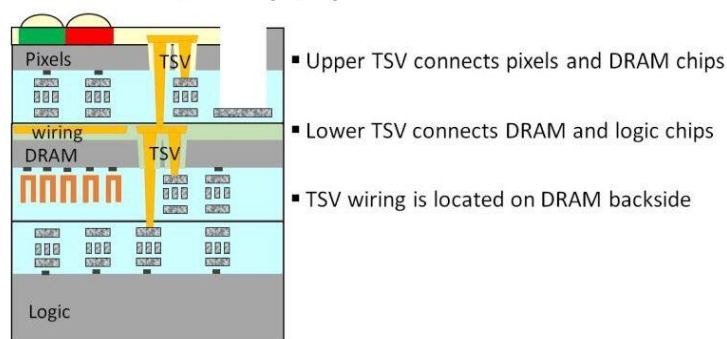


See <http://electroiq.com/insights-from-leading-edge/2017/08/iftle-346-sony-introduces-stacked-image-sensor-with-dram-in-xperia-xz-phones/>
 See also https://www.systemplus.fr/wp-content/uploads/2017/07/SP17343_Sony_IMX400_Trilayer_Stacked_CIS_Flyer_System_Plus_Consulti.pdf

61. As another example, shown below, are illustrations of Sony's triple-die stacked CIS that include a number of distributed TSVs connecting the top pixel layer with the middle DRAM layer and the middle DRAM layer with the bottom logic layer.



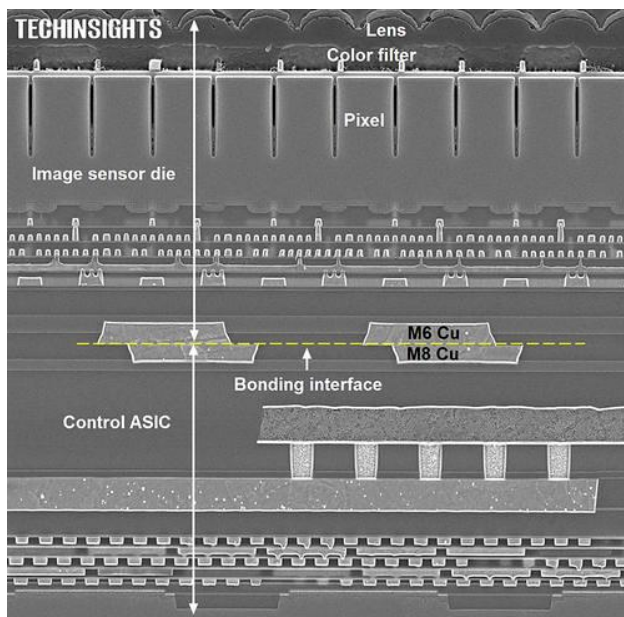
Device structure (2/3)

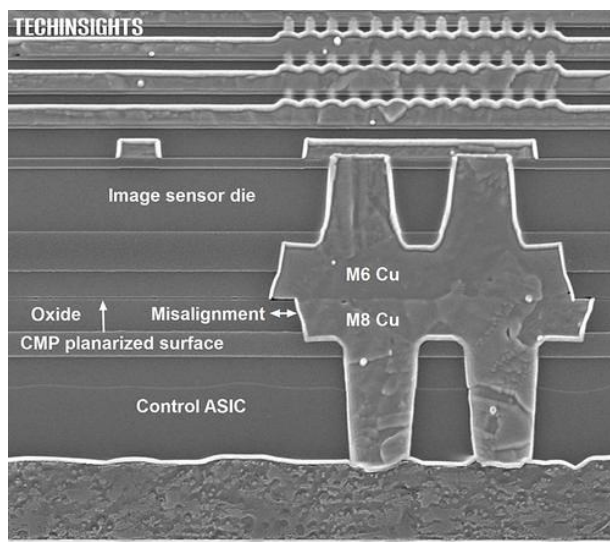


See <https://fuse.wikichip.org/news/763/iedm-2017-sonys-3-layer-stacked-cmos-image-sensor-technology/>

See also <http://image-sensors-world.blogspot.com/2018/01/sony-iedm-presentation-of-3-layer.html>

62. IMX includes the ASIC logic die and the image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements through a thickness thereof.

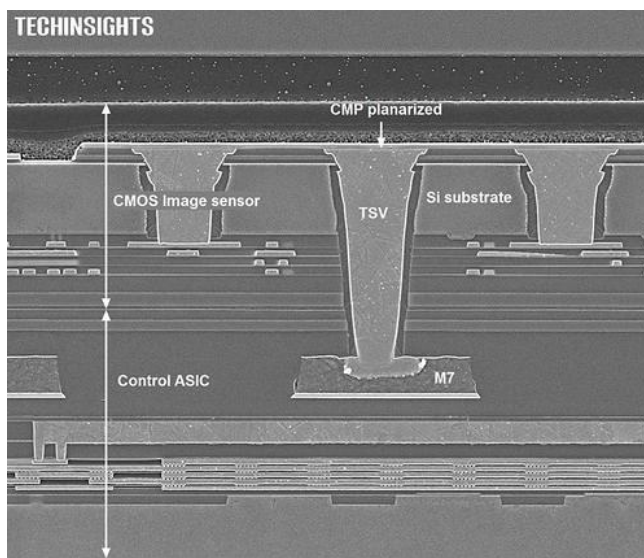




See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

See also <http://image-sensors-world.blogspot.com/2016/03/sony-imx260-in-samsung-galaxy-s7.html>

63. IMX includes the control ASIC die and the CMOS image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.



See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

64. To the extent the '226 Accused Products includes components or software owned or manufactured by third parties, the Accused Products still infringe the '226 Patent because Defendants are vicariously liable for making, selling, offering for sale, and/or using the patented technology by controlling the design and operation of the '226 Accused Products that are made, used and sold. Further, Defendants derive a benefit from the manufacture and use of every element of the entire system

65. Defendants' infringement of the '226 Patent injured Arbor in an amount to be proven at trial, but not less than a reasonable royalty.

COUNT II
(Indirect Infringement of the '226 Patent pursuant to 35 U.S.C. § 271(b))

66. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

67. In addition to directly infringing the '226 Patent, Defendants knew or were willfully blind to the fact that they were inducing infringement under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties on the manufacture and use of the '226 Accused Products.

68. Additionally, Defendants knew or were willfully blind to the fact that they were inducing infringement under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties, including customers, manufactures, suppliers and agents, on the manufacture and use of the '226 Accused Products, either literally or under the doctrine of equivalents.

COUNT III

(Direct Infringement of the '951 Patent pursuant to 35 U.S.C. § 271(a))

69. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

70. Defendants infringe at least Claim 1 of the '951 Patent in violation of 35 U.S.C. § 271(a).

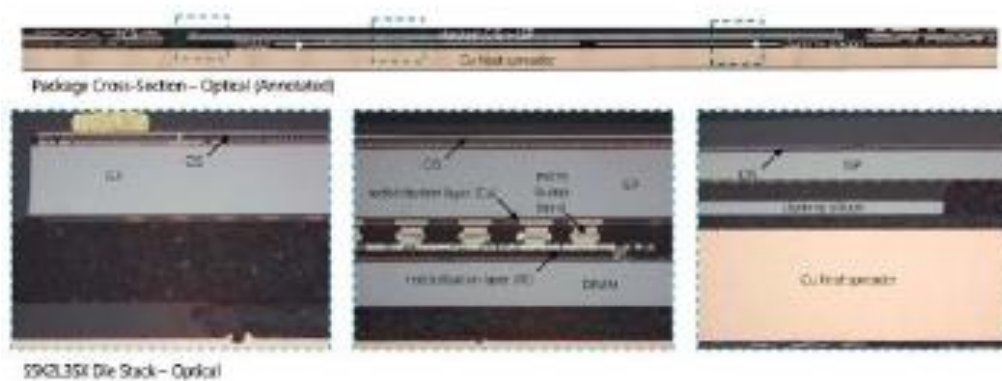
71. Defendants' infringement is based upon literal infringement or, in the alternative, infringement under the doctrine of equivalents.

72. Defendants' acts of making, using, importing, selling, and offering for sale infringing products and services were without the permission, consent, authorization, or license of Arbor.

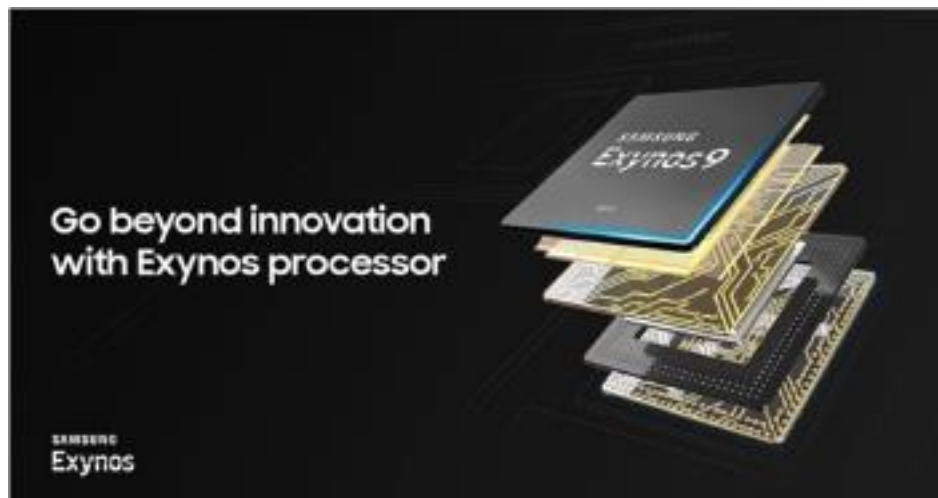
73. Defendants' infringement included, the manufacture, use, sale, importation and offer for sale of Defendant's IC products that utilize processor modules that include multiple die elements stacked and electronically coupled through TSVs, including Samsung Exynos, ISOCELL, DDR4 Memory, IMX Sensor, and products includes these chips, including Galaxy mobile phones, Galaxy Note, camera's, and Samsung computers, and including those Samsung products that use Sony IMX image sensors (collectively, the "'951 Accused Products").

74. The '951 Accused Products practice the patented invention of the '951 Patent and infringed the '951 Patent because they make, sell, offer for sale, and/or use the Accused Products which include processor modules that include multiple die elements stacked and electronically coupled through TSVs. Using the patented technology, the form factors of the '951 Accused Products can be in a size that is reduced without compromising capabilities.

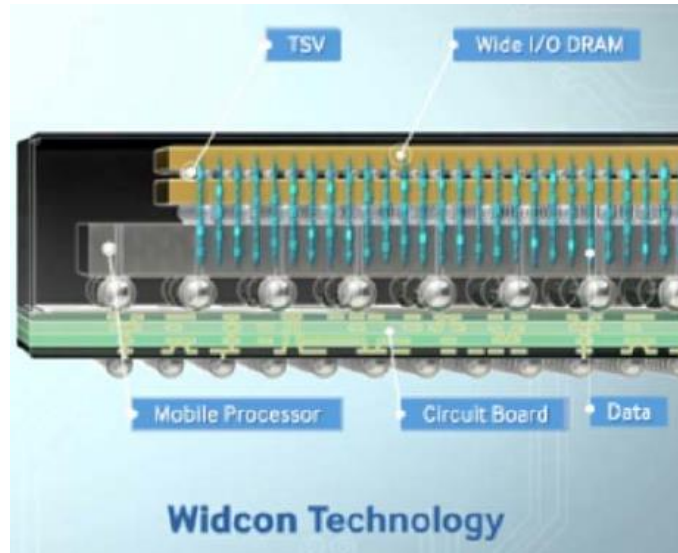
Samsung S5K2L3SX Overview



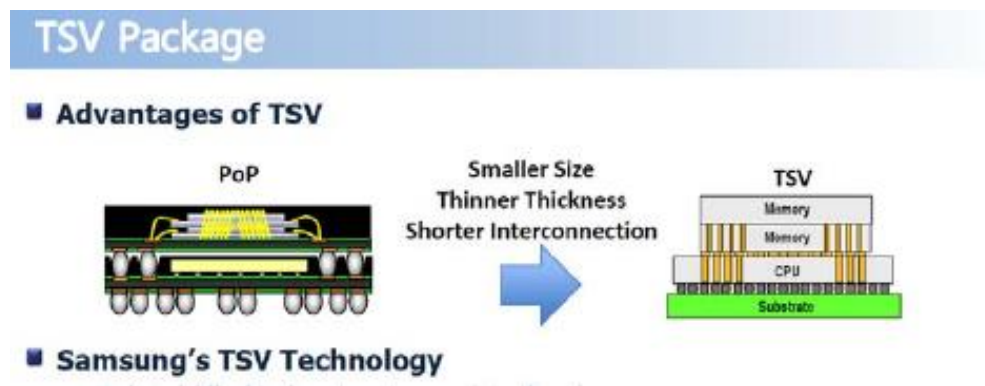
75. The Samsung Exynos is a processor that includes a first IC functional element that is programmable as a processing element. For example, the Samsung Exynos is a mobile processor that includes at least an IC, such as a central processing unit, a graphics processing unit, and a DRAM. The DRAM can function as an IC functional element for data storage and retrieval.



76. Samsung Exynos included an IC functional element stacked with and electrically coupled to a programmable array of the IC functional element. Samsung Exynos includes an IC functional element, such as the CPU, that is stacked over and electrically coupled to another IC functional element, such as the DRAM unit using TSVs.



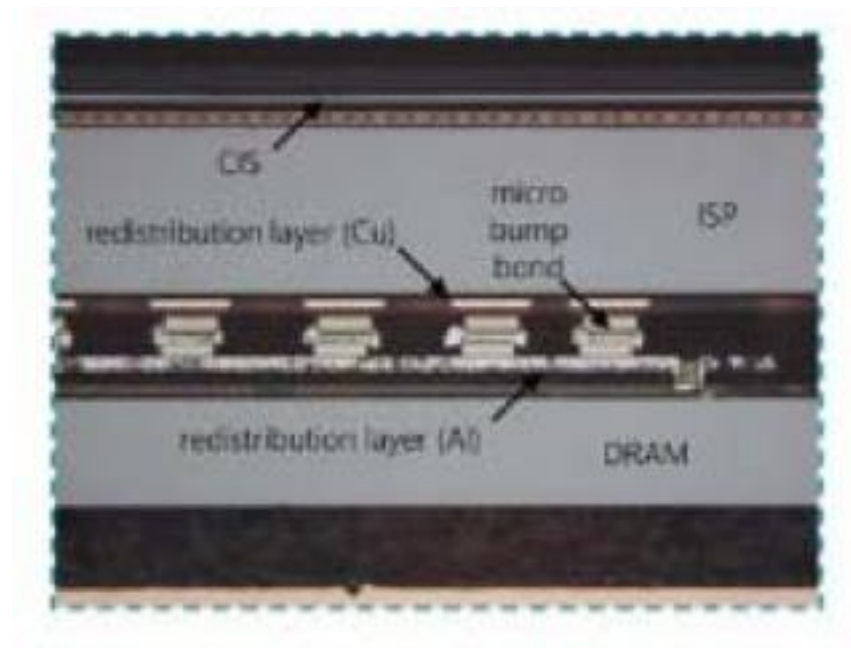
77. Samsung has developed TSV based heterogeneous die-stacking technology for applications in mobile processor modules. Samsung's TSV technology focuses on using TSVs to connect multiple functional elements, such as memories and CPUs, for faster processing speeds and increased memory bandwidths. This technology has been referred to as Samsung's Widcon Technology.



78. Samsung Exynos modules have IC functional elements that are electrically coupled by contact points distributed throughout the surfaces of said functional elements, and wherein an IC includes a memory array functional to accelerate external memory references to the processing element. Samsung Exynos include an IC functional element, such as the DRAM

unit, and IC die element, such as the CPU. Where DRAM is programmable as a processing element and functional to accelerate reconfiguration. The DRAM unit can function as an IC for data storage and retrieval to accelerate reconfiguration of CPU.

79. Samsung's ISOCELL is an image processing modules that include at least an IC functional element that is programmable as a processing element, such as an image signal processor (ISP) shown below.



80. Samsung ISOCELL includes IC functional elements, such as the CIS or image signal processor (ISP), stacked with and electrically coupled to the programmable RDL and DRAM of the IC. Samsung ISOCELL includes 3-layers which are interconnected by TSVs. The ISP is programmable in the IC functional element, and is electrically coupled to the RDL and DRAM layer, another IC functional element.

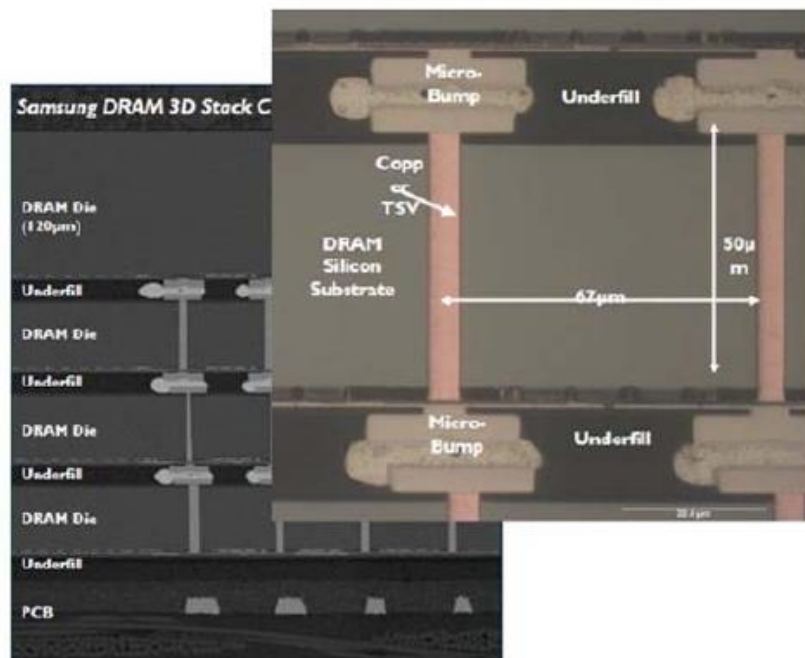
81. Samsung ISOCELL includes an IC functional element, such as such as the ISP and another IC functional element, such as the RDL and DRAM layer, electrically coupled by a

number of contact points distributed using TSVs. The RDL and DRAM layer includes memory to accelerate the interface between the ISP and external memory.

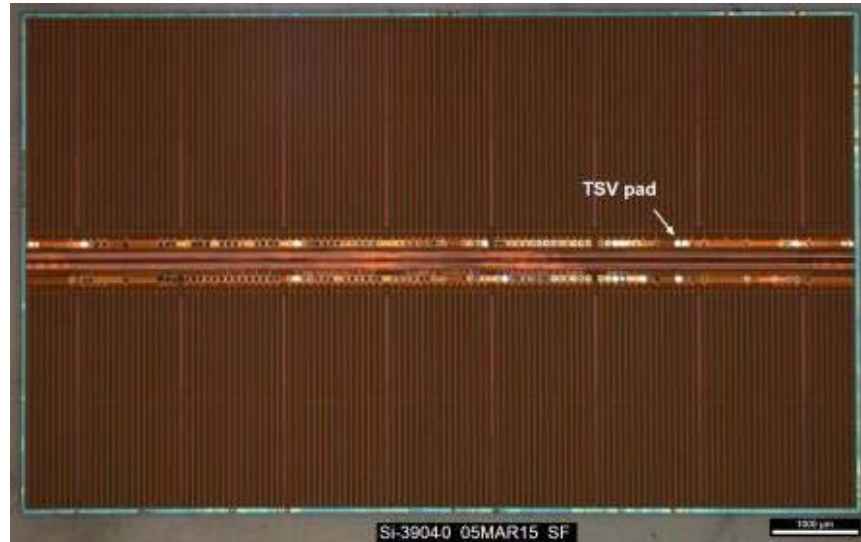
82. Samsung's TSV method allows Samsung to assemble its ISOCELL stack by micro-bumping a standard DRAM chip face-to-back on the ISP. The DRAM micro bump lands are connected to a RDL formed over the DRAM.

83. On the ISP side, the micro bump lands connect to a Cu-based RDL formed on the back of the ISP. The ISP RDL routes the micro bump connection to TSVs extending through the ISP substrate to front metal TSV lands. The use of the TSV to interconnect the ISP and RDL and DRAM accelerates the interface.

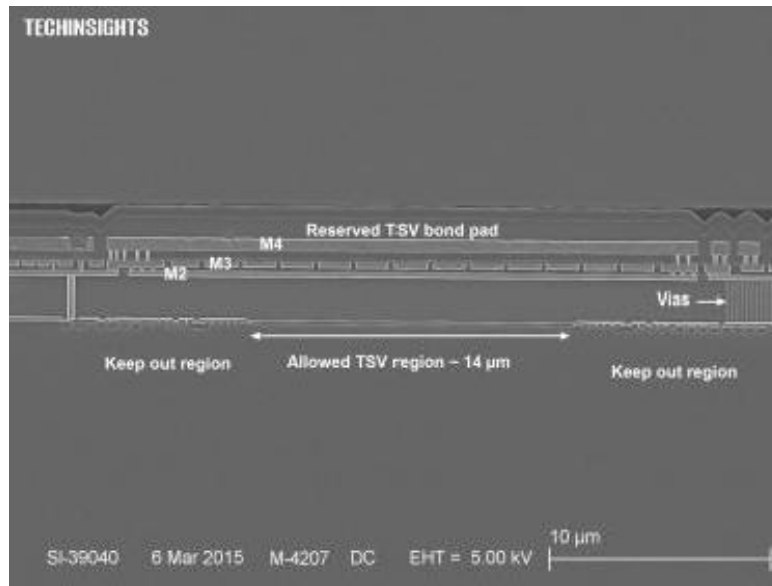
84. Samsung DDR4 is designed and used to work with processor chips comprising at least an IC functional element that is programmable as a processing element. Samsung DDR4 includes an IC functional element that is programmable as a processing element. As shown below, Samsung DDR4 includes multiple memory die elements stacked over each other and electrically connected with TSVs.



85. Samsung DDR4 includes memory modules that are programmable as a memory layer with an array of individual memory cells mapped to correspond to a logical layer using programmable address lines. A hardware based memory management unit (“MMU”) interfaces with the DRAM module and other processing modules. Each of the memory die elements is programmable for the storage and retrieval data.



86. Samsung DDR4 includes an IC functional element stacked with and electrically coupled using TSVs. As seen from the cross-sectional images below of Samsung DDR4, each memory die element includes an allowed TSV region for TSVs that connect to another memory die element below. Also shown below, these are TSVs connecting the memory die element to another die element.

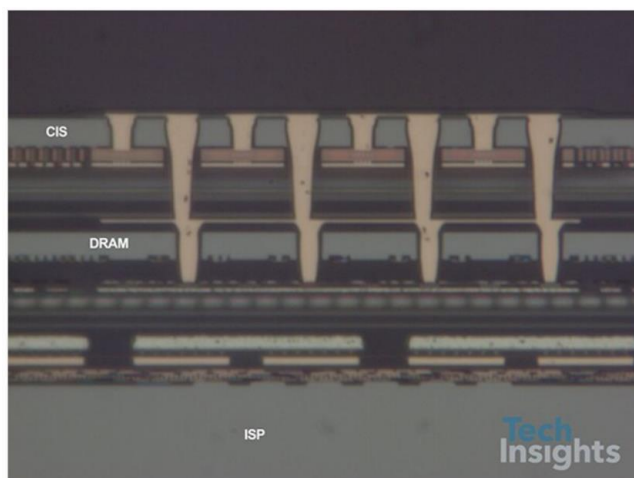


87. Samsung DDR4 includes IC die elements are electrically coupled by a number of contact points, such as TSVs, distributed throughout the surfaces of the die elements, and wherein the contact points traverse the die elements through a thickness thereof.

88. Samsung DDR4 includes a number of contact points, such as TSVs, for connecting one memory die element to another. The TSVs are seen to be distributed throughout the surface of the die elements, wherein each DRAM die element is electrically connected to another DRAM die element.

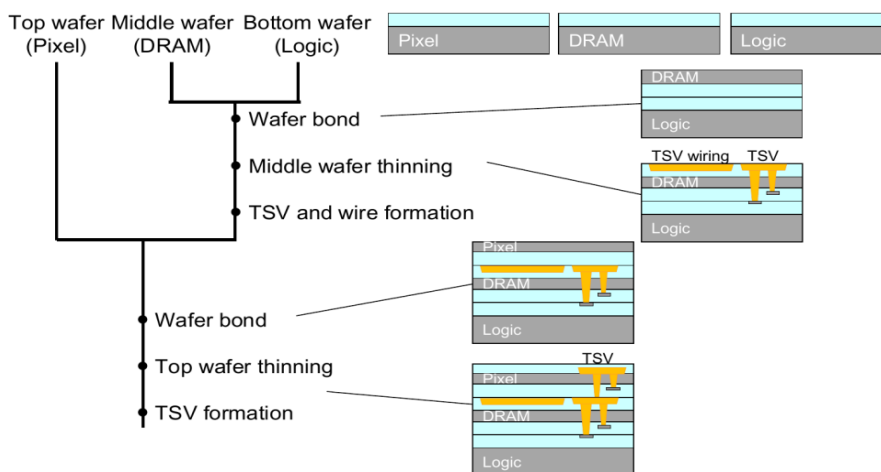
89. IMX Sensor includes an IC die element, such as the DRAM cell array, and another IC die element, such as the CIS, electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements, and wherein the contact points traverse each of the die elements through a thickness thereof.

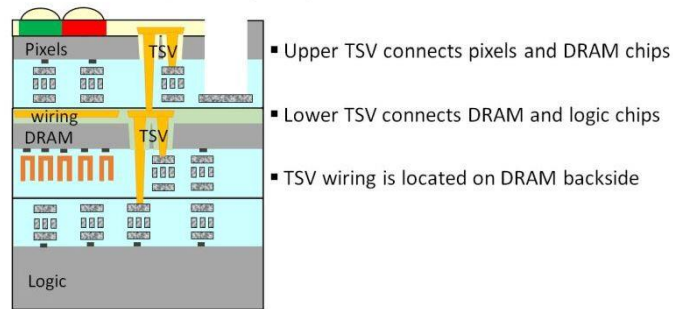
90. IMX Sensor includes the DRAM cell array and the CIS IC die elements that are electrically coupled by a number of contact points, such as TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.



See <http://electroiq.com/insights-from-leading-edge/2017/08/iftle-346-sony-introduces-stacked-image-sensor-with-dram-in-xperia-xz-phones/>
 See also https://www.systemplus.fr/wp-content/uploads/2017/07/SP17343_Sony_IMX400_Trilayer_Stacked_CIS_Flyer_System_Plus_Consulti.pdf

91. IMX Sensor can be triple-die stacked CIS that include a number of distributed TSVs connecting the top pixel layer with the middle DRAM layer and the middle DRAM layer with the bottom logic layer.

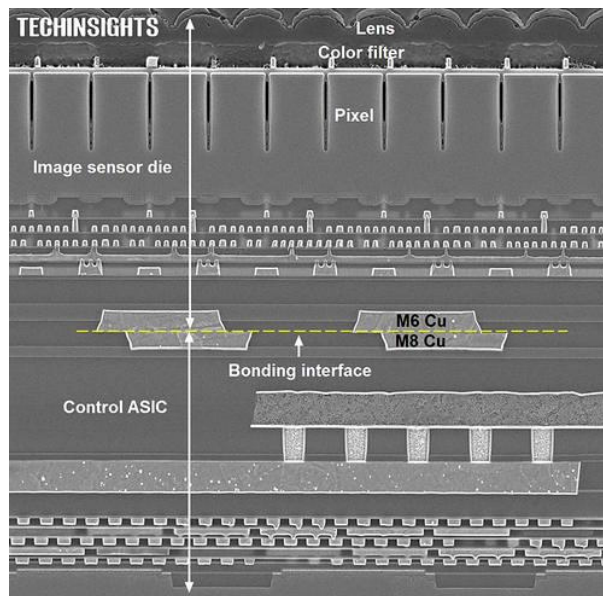


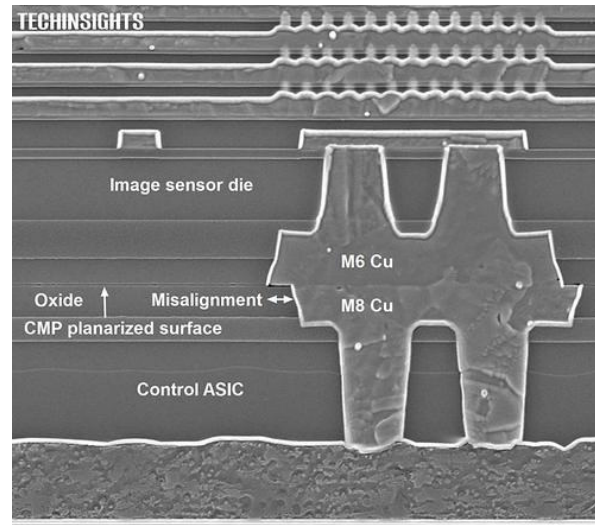
Device structure (2/3)

See <https://fuse.wikichip.org/news/763/iedm-2017-sonys-3-layer-stacked-cmos-image-sensor-technology/>

See also <http://image-sensors-world.blogspot.com/2018/01/sony-iedm-presentation-of-3-layer.html>

92. IMX Sensor can also include the ASIC logic die and the image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements through a thickness thereof.

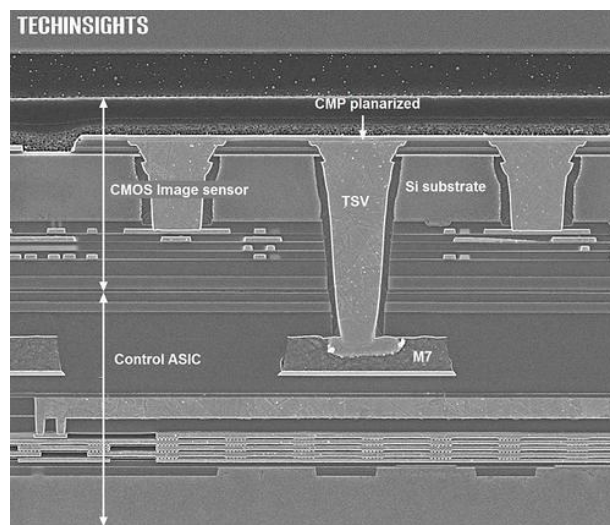




See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

See also <http://image-sensors-world.blogspot.com/2016/03/sony-imx260-in-samsung-galaxy-s7.html>

93. IMX Sensor includes the control ASIC die and the CMOS image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.



See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

94. To the extent the '951 Accused Products includes components or software owned or manufactured by third parties, the Accused Products still infringe the '951 Patent because Defendants are vicariously liable for making, selling, offering for sale, and/or using the patented technology by controlling the design and operation of the '951 Accused Products that are made, used and sold. Further, Defendants derive a benefit from the manufacture and use of every element of the entire system.

95. Defendants' infringement of the '951 Patent injured Arbor in an amount to be proven at trial, but not less than a reasonable royalty.

COUNT IV
(Indirect Infringement of the '951 Patent pursuant to 35 U.S.C. § 271(b))

96. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

97. In addition to directly infringing the '951 Patent, Defendants knew or were willfully blind to the fact that they were inducing infringement under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties on the manufacture and use of the '951 Accused Products.

98. Additionally, Defendants knew or were willfully blind to the fact that they were inducing infringement under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties, including customers, manufactures, suppliers and agents, on the manufacture and use of the '951 Accused Products, either literally or under the doctrine of equivalents.

COUNT V

(Direct Infringement of the '035 Patent pursuant to 35 U.S.C. § 271(a))

99. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

100. Defendants infringe at least Claim 1 of the '035 Patent in violation of 35 U.S.C. § 271(a).

101. Defendants' infringement is based upon literal infringement or, in the alternative, infringement under the doctrine of equivalents.

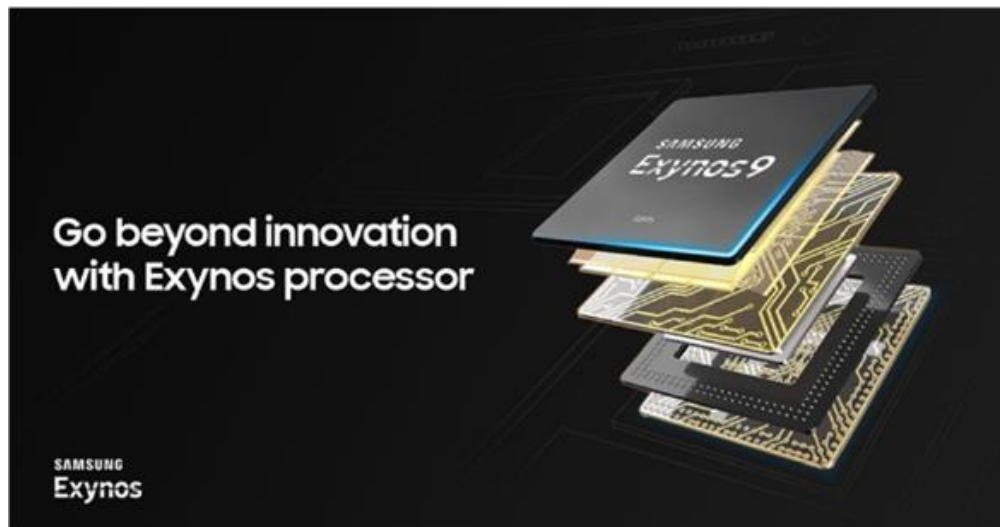
102. Defendants' acts of making, using, importing, selling, and offering for sale infringing products and services were without the permission, consent, authorization, or license of Arbor.

103. Defendants' infringement included, the manufacture, use, sale, importation and offer for sale of Defendant's IC products that utilize processor modules that include multiple die elements stacked and electronically coupled through TSVs, including Samsung Exynos, ISOCELL, DDR4 Memory, IMX Sensor, and products includes these chips, including Galaxy mobile phones, Galaxy Note, cameras, and Samsung computers, and including those Samsung products that use Sony IMX image sensors (collectively, the "'035 Accused Products").

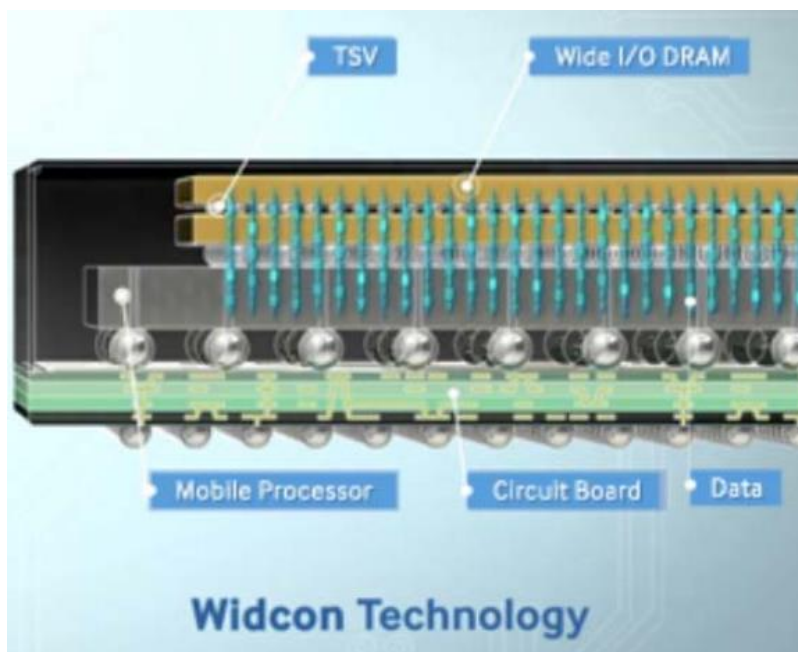
104. The '035 Accused Products practice the patented invention of the '035 Patent and infringed the '035 Patent because they make, sell, offer for sale, and/or use the '035 Accused Products which include processor modules that include multiple die elements stacked and electronically coupled through TSVs. Using the patented technology, the form factors of the '035 Accused Products can be in a size that is reduced without compromising capabilities.

105. Samsung Exynos is a processor module that includes IC die elements, including a memory array. For example, the Samsung Exynos is a mobile processor module that includes an

IC, such as a central processing unit, a graphics processing unit, and a DRAM unit. The DRAM unit can function as a programmable array for data storage and retrieval.



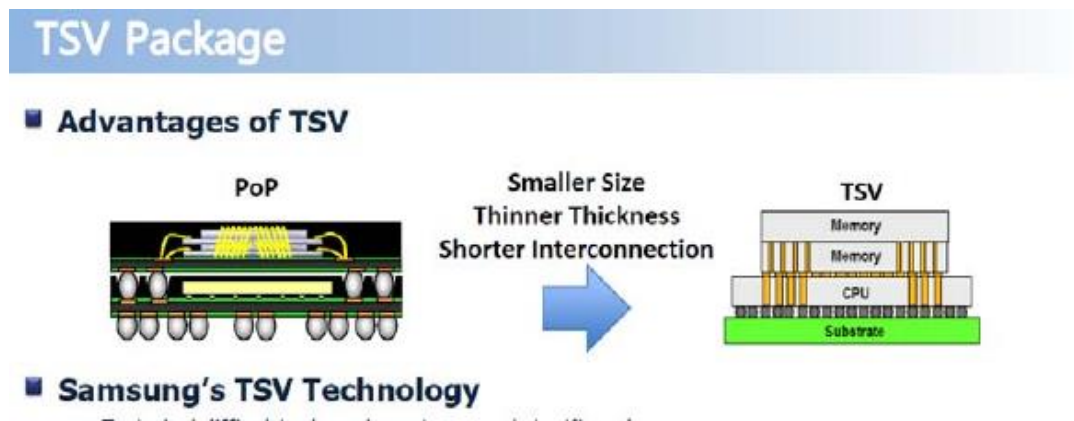
106. Samsung Exynos includes an IC die element, such as the CPU, that is stacked with and electrically coupled to programmable DRAM on the IC die element. Samsung Exynos processor module includes an IC die element, such as the CPU, that is stacked over and electrically coupled to the IC die element using TSVs.



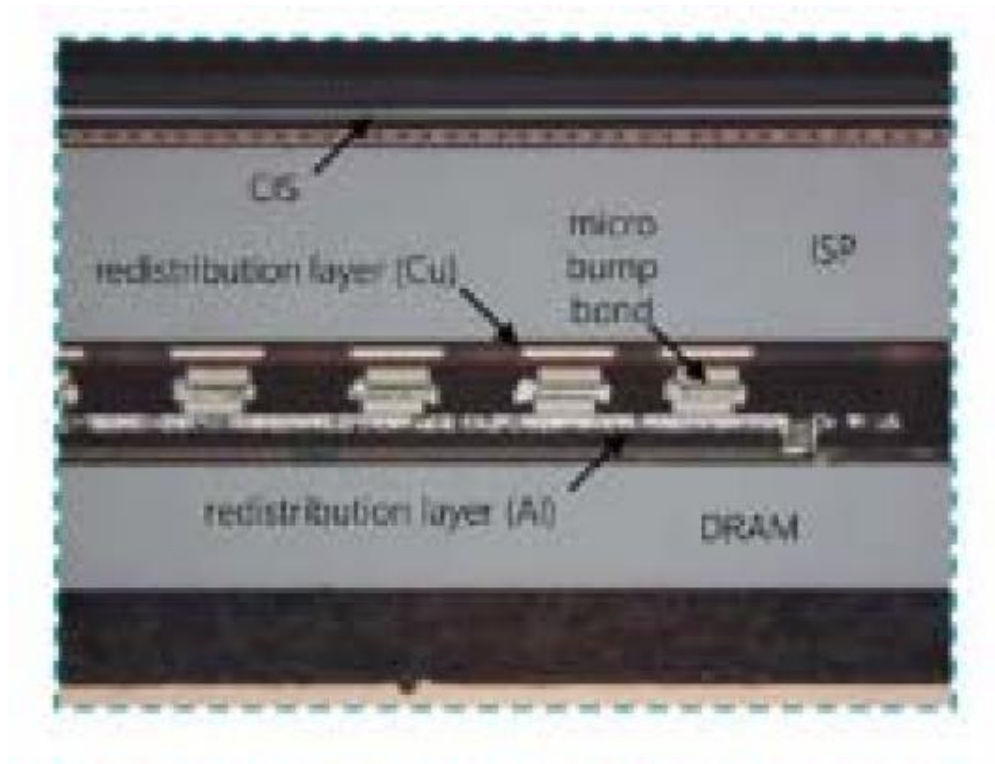
107. Samsung developed TSV based heterogeneous die-stacking technology for applications in mobile processor modules. Samsung's TSV technology focuses on using TSVs to connect multiple die elements, such as memories and CPUs, for faster processing speeds and increased memory bandwidths. This technology has been referred to as Samsung's Widcon Technology.

108. Samsung Exynos includes the IC die element, such as the DRAM unit, and another IC die element, such as the CPU, electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements, and wherein the contact points traverse each of the die elements through a thickness thereof.

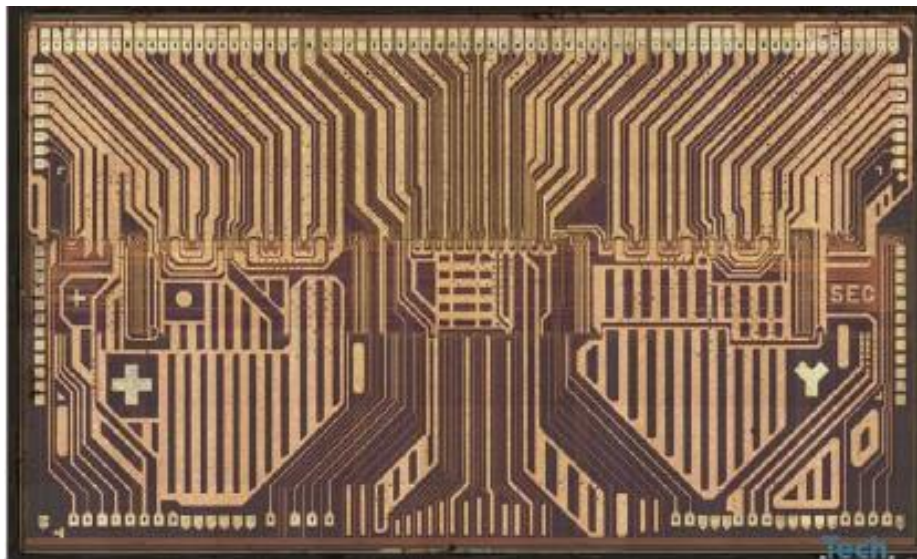
109. Samsung Exynos includes the DRAM and the CPU IC die elements electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSV traverses each of the die elements.



110. Samsung's ISOCELL includes an IC die element with a programmable array based on a RDL and DRAM layer. The image below shows the ISOCELL. The chip includes 3-layers interconnected by TSVs. The RDL and DRAM layers interface with the ISP.



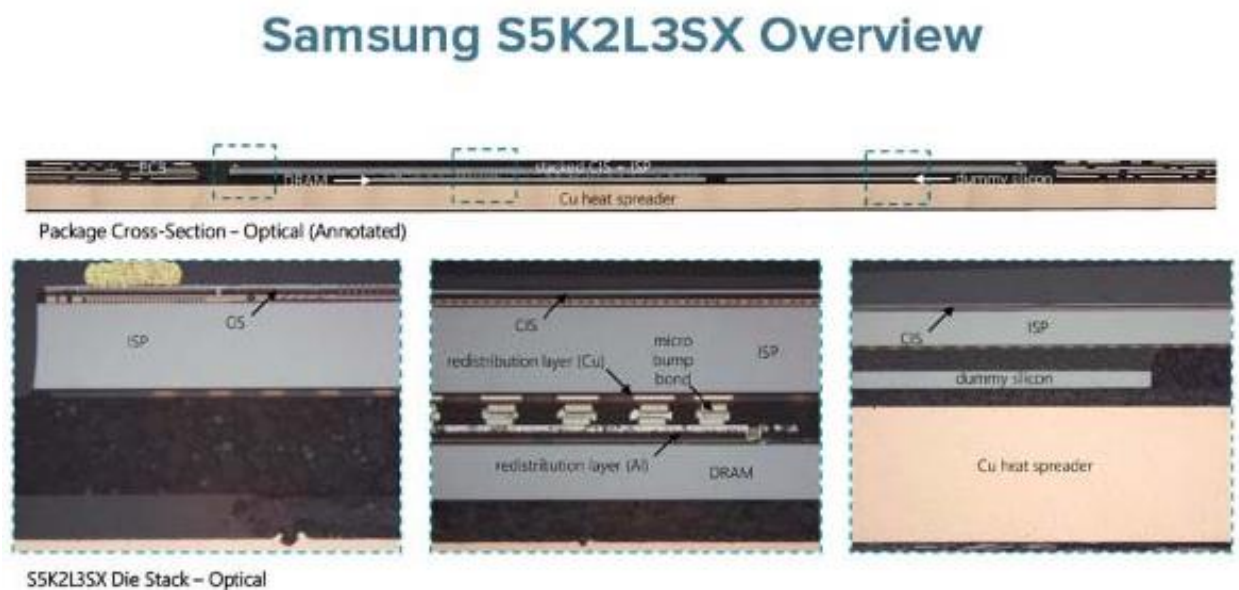
111. Shown below is a DRAM die with the RDL intact. The RDL routes the bump lands to the die bond pads located along the DRAM to configure the DRAM to the ISP.



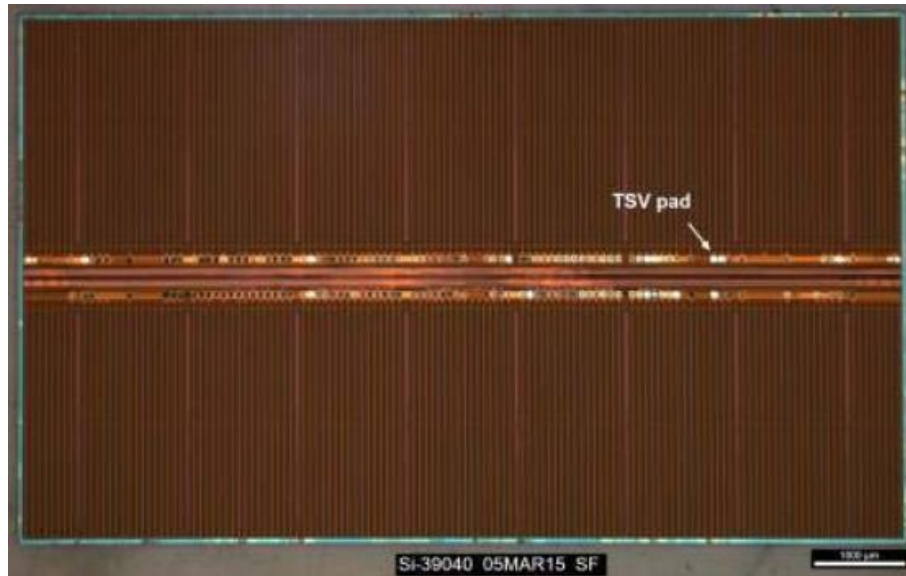
112. Samsung's ISOCELL includes an IC die element, such as an ISP that is stacked with and electrically coupled to the DRAM cell array of IC die element. The IC includes 3-layers which are interconnected by TSVs. The ISP is an IC die element stacked with and

electrically coupled to the RDL and DRAM layer. Samsung's ISOCCELL includes the DRAM cell arrays, and IC die elements, such as the ISP, electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements, and wherein the contact points traverse each of the die elements and using TSVs for interconnects.

113. Samsung's ISOCCELL uses micro-bumping of a standard DRAM chip face-to-back on the ISP. The DRAM micro bump lands are connected to an RDL formed over the DRAM. On the ISP side, the micro bump lands connect to the RDL formed on the back of the ISP. The ISP RDL routes the micro bump connection to TSVs extending through the ISP substrate to front metal TSV lands. The assembly also includes a dummy silicon structure filling the unoccupied space next to the DRAM chip.

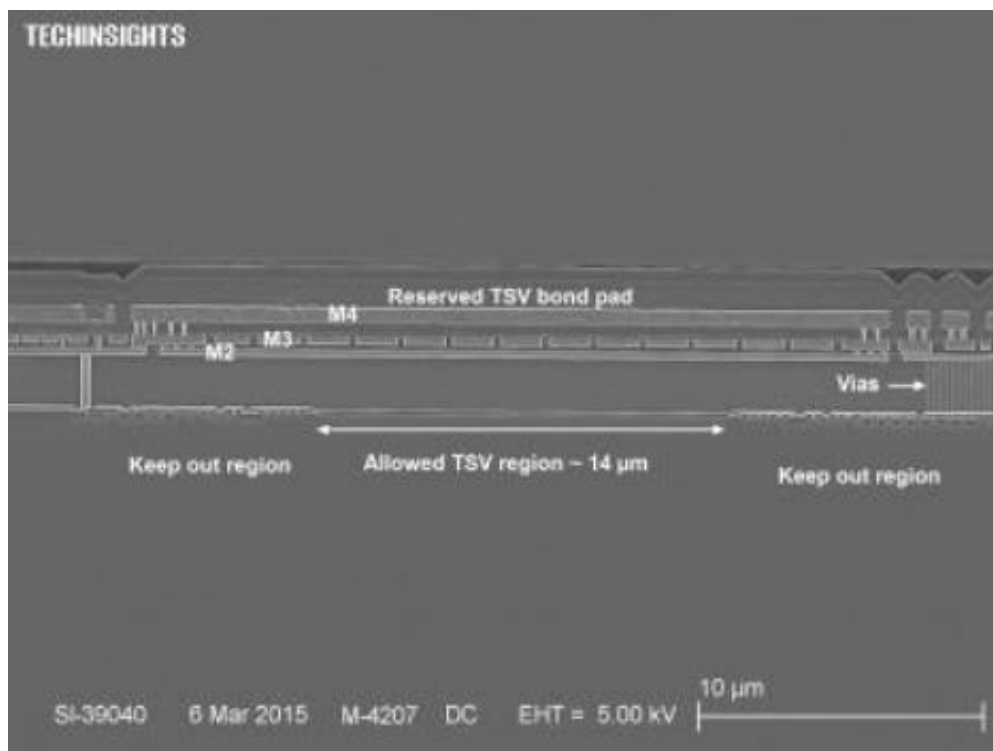


114. Samsung DDR4 is memory that works with processor chips for computational and data processing applications. DDR4 includes at an IC die element with a programmable array and includes multiple memory die elements stacked over each other and electrically connected with TSVs. Each of these memory die elements are programmable for the storage and retrieval of data.

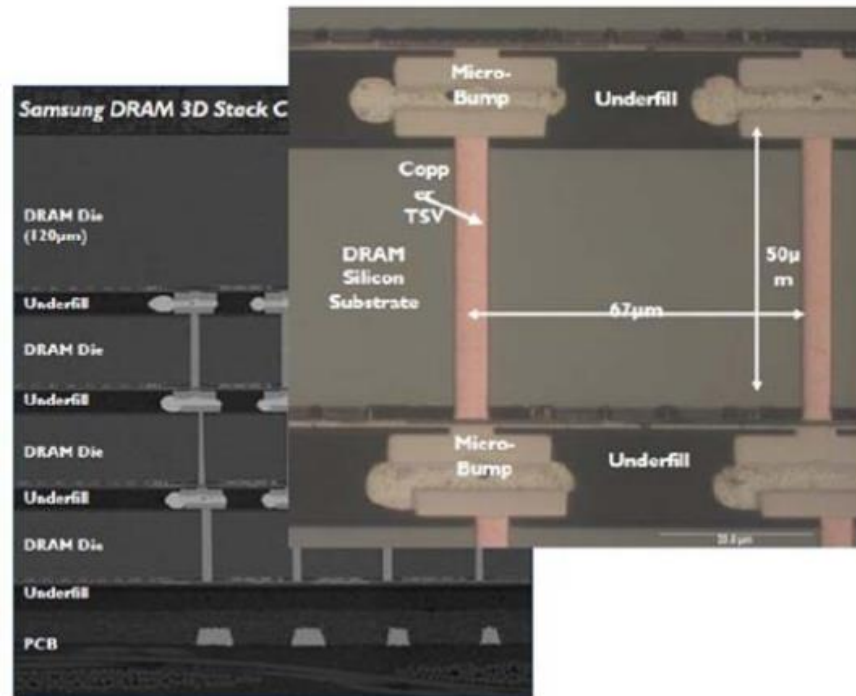


115. Samsung DDR4 has a physical memory layer that includes the array of individual memory cells mapped or programmed to correspond to a logical layer using programmable address lines. A hardware based MMU that interfaces with the DRAM module and other processing modules for the DDR4 processor modules because they include at least an IC die element stacked with and electrically coupled to the array of the IC die element using TSVs.

116. Samsung DDR4 includes an IC die element that is stacked over and electrically connected to another IC die element using TSVs. As seen from the cross-sectional images below of Samsung's DDR4, each memory die element includes an allowed TSV region to connect to another memory die element.

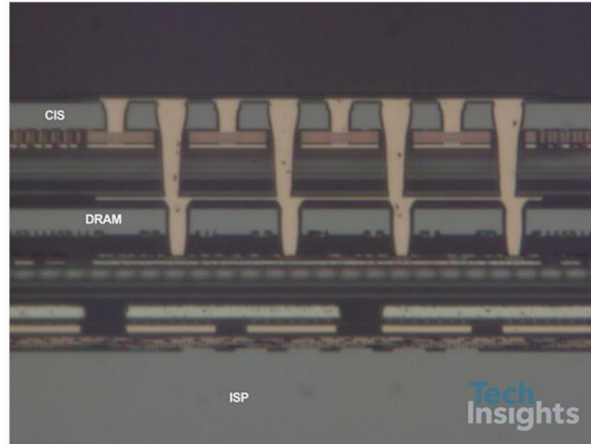


117. Samsung DDR4 has IC die elements electrically coupled by a number of contact points, such as TSVs, distributed throughout the surfaces of the die elements, and wherein the contact points traverse the die elements through a thickness thereof. Samsung DDR4 modules include a number of contact points for connecting one memory die element to another. The TSVs are seen to be distributed throughout the surface of the die elements, wherein each DRAM die element is electrically connected to another DRAM die element using TSVs.



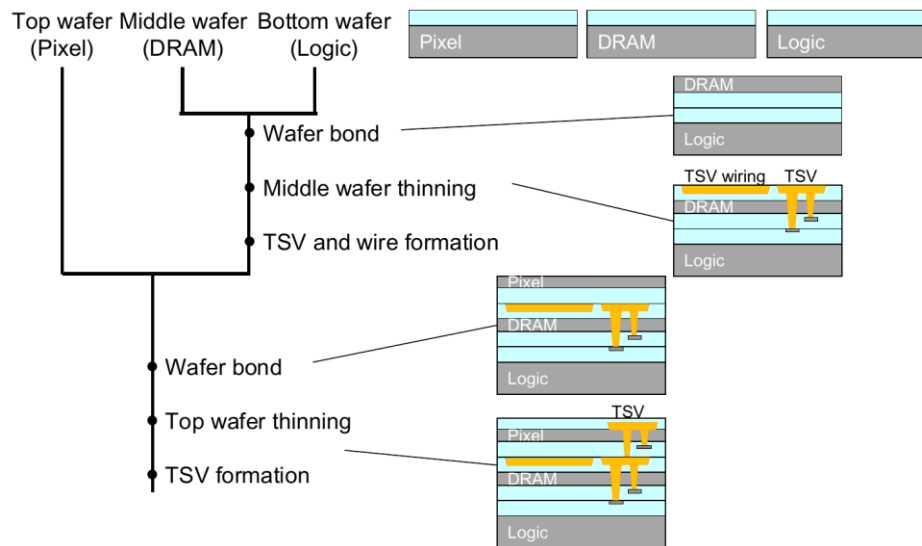
118. IMX Sensor includes an IC die element, such as the DRAM cell array, and another IC die element, such as the CIS, electrically coupled by a number of contact points distributed throughout the surfaces of each of the die elements, and wherein the contact points traverse each of the die elements.

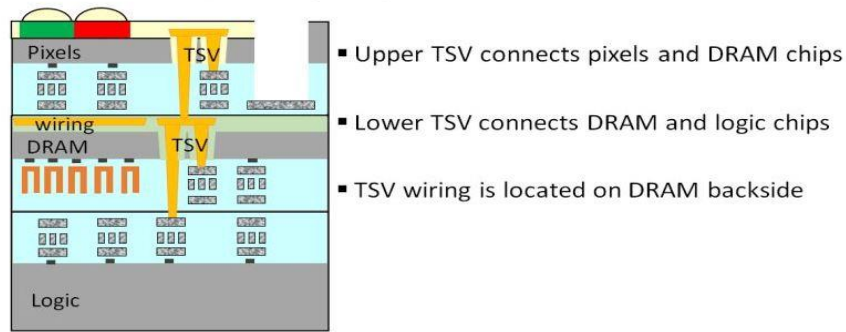
119. IMX Sensor includes the DRAM cell array and the CIS integrated circuit die elements that are electrically coupled by a number of contact points, such as TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.



See <http://electroiq.com/insights-from-leading-edge/2017/08/iftle-346-sony-introduces-stacked-image-sensor-with-dram-in-xperia-xz-phones/>
 See also https://www.systemplus.fr/wp-content/uploads/2017/07/SP17343_Sony_IMX400_Trilayer_Stacked_CIS_Flyer_System_Plus_Consulti.pdf

120. IMX Sensor can be a triple-die stacked CIS that include a number of distributed TSVs connecting the top pixel layer with the middle DRAM layer and the middle DRAM layer with the bottom logic layer.

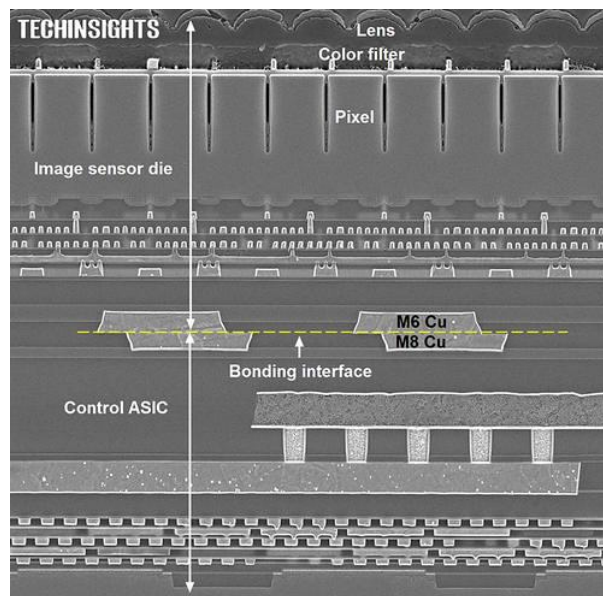


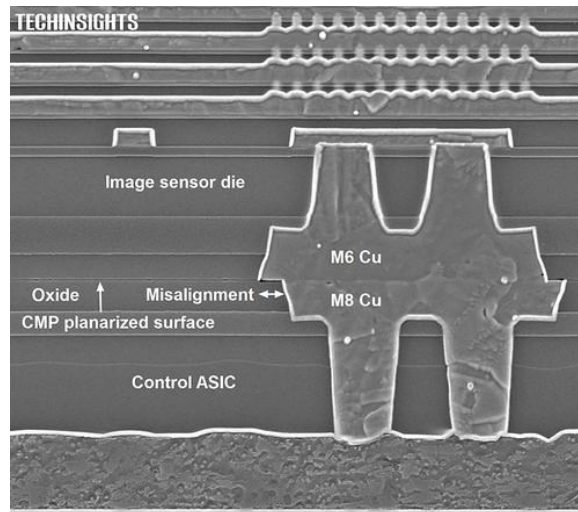
Device structure (2/3)

See <https://fuse.wikichip.org/news/763/iedm-2017-sonys-3-layer-stacked-cmos-image-sensor-technology/>

See also <http://image-sensors-world.blogspot.com/2018/01/sony-iedm-presentation-of-3-layer.html>

121. IMX Sensor can also include the ASIC logic die and the image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements through a thickness thereof.

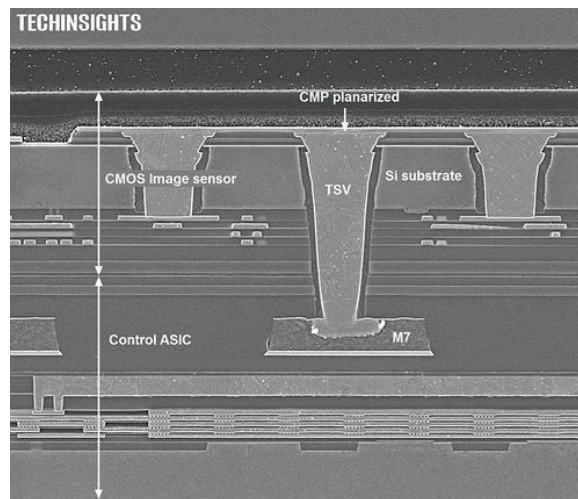




See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

See also <http://image-sensors-world.blogspot.com/2016/03/sony-imx260-in-samsung-galaxy-s7.html>

122. IMX Sensor also includes the control ASIC die and the CMOS image sensor die elements that are electrically coupled by a number of contact points, such as the TSVs, distributed throughout the surfaces of each of the die elements, and wherein the TSVs traverse each of the die elements.



See <https://www.ednasia.com/news/article/samsung-s7-s-two-image-sensors-what-s-the-difference-2>

123. To the extent the '035 Accused Products includes components or software owned or manufactured by third parties, the '035 Accused Products still infringe the '035 Patent because Defendants are vicariously liable for making, selling, offering for sale, and/or using the patented technology by controlling the design and operation of the '035 Accused Products that are made, used and sold. Further, Defendants derive a benefit from the manufacture and use of every element of the entire system.

124. Defendants' infringement of the '035 Patent injured Arbor in an amount to be proven at trial, but not less than a reasonable royalty.

COUNT VI
(Indirect Infringement of the '035 Patent pursuant to 35 U.S.C. § 271(b))

125. Arbor repeats, realleges, and incorporates by reference, as if fully set forth herein, the allegations of the preceding paragraphs, as set forth above.

126. In addition to directly infringing the '035 Patent, Defendants knew or were willfully blind to the fact that they were inducing infringement of the '035 Patent under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties on the manufacture and use of the '035 Accused Products.

127. Additionally, Defendants knew or were willfully blind to the fact that they were inducing infringement of the '035 Patent under 35 U.S.C. § 271(b) by instructing, directing and/or imposing requirement to third parties, including customers, manufactures, suppliers and agents, on the manufacture and use of the '035 Accused Products, either literally or under the doctrine of equivalents.

PRAYER FOR RELIEF

WHEREFORE, Arbor prays for judgment and relief as follows:

- A. An entry of judgment holding that Defendants infringed the ‘226, ‘951, and ‘035 Patents; induced infringement of the ‘226, ‘951, and ‘035 Patents.
- B. An award to Arbor of such past damages, not less than a reasonable royalty, as it shall prove at trial against Defendants that is adequate to fully compensate Arbor for Defendants’ infringement of the ‘226, ‘951, and ‘035 Patents;
- C. A finding that this case is “exceptional” and/or an award to Arbor of its costs and reasonable attorneys’ fees, as provided by 35 U.S.C. § 285;
- D. An accounting of all infringing sales and revenues, together with post judgment interest and prejudgment interest from the first date of infringement of the ‘226, ‘951, and ‘035 Patents; and
- E. Such further and other relief as the Court may deem proper and just.

DEMAND FOR JURY TRIAL

Arbor demands a jury trial on all issues so triable.

Respectfully submitted,

Dated: October 11, 2019

/s/ Elizabeth L. DeRieux
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Lisa Kobialka (*Pro Hac Vice* Motion to be Filed)

California Bar No. 191404
James Hannah (*Pro Hac Vice* Motion to be Filed)
California Bar No. 237978
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